The Science Teacher

DECEMBER

1942

Volume IX

Number 4

Published
OCTOBER
DECEMBER
FEBRUARY
APRIL

Photomicrograph of an oriole's feather (See page 10.)

In this issue —

A National Service Journal

The Science Teacher

Official Journal of

American Council of Science Teachers

A department of the National Education Association

American Science Teachers Association

Associated with American Association for Advancement of Science

And State and Regional Associations

Association directors will be announced in a later issue of this journal. Science teachers' associations are invited to affiliate with the American Council of Science Teachers. For information, write to any officer.

Science teachers' organizations are invited to affiliate with the American Science Teachers Association. For information write to any officer.

THE TENTH ANNUAL meeting of the American Science Teachers Association will be held in New York City, December 28, 1942.

AMERICAN SCIENCE TEACHERS ASSOCIATION

Affiliated Organizations and Directors

National Assn. for Research in Science Teaching — Hanor A. Webb, George Peabody College for Teachers, Nashville, Tenn.

New York State Science Teachers Assn.— Nelson Beeler, 49 Elysian Ave., Nyack, N. Y.;Edna Craig, Newburgh High School, Newburgh, N. Y.; T. L. Shull, Central H. S., Valley Stream, N. Y.

The Texas Assn. of Science Teachers—Don O. Baird, State Teachers College, Huntsville.

Nebraska State Science Teachers Assn.—J. D. Young, Lincoln H. S., Lincoln, Nebraska.

Chemistry Teachers Club of New York City— Valentine Mayforth, DeWitt Clinton High School, Mosholu Parkway and Paul Ave.

South Dakota Round Tables of Science—J. H. Jensen, Northern Normal School, Aberdeen.

New England Biological Assn.— Leo J. Fitzpatrick, Brockton, Mass.

Eastern Assn. of Physics Teachers — Homer W. LeSourd, Milton Academy, Milton, Mass.

The Physics Club of New York — Morris Meister, Principal, Bronx High School of Science, 184th St. and Creston Ave.

National Council on Elementary Science — Florence Billig, Wayne University, Detroit.

Cleveland Natural Science Club — Ellis C. Persing, Western Reserve University.

New Jersey State Science Teachers Assn. — Rufus D. Reed State Teachers College, Montclair, N. J.

Assn. of Science Teachers of the Middle States — Earl R. Glenn, State Teachers College, Montclair, N. J.

General Science Assn. of New York City — Abraham Raskin, Bronx High School of Science, 184th St. and Creston Ave.

Philadelphia Science Teachers Assn.— Elmer Field, S. Philadelphia High School for Girls.

New York Assn. of Biology Teachers —Charles Gramet, Midwood High School, Brooklyn.

New England Assn. of Chemistry Teachers — Laurence S. Foster, Brown University, Providence, R. I.

Duquesne University Conference for Teachers of Science in Catholic High Schools — Hugh C. Muldoon, Duquesne University, Pittsburg, Pa.

Science Conference Group of St. Mary's College—Sister M. Lucretia, St. Mary's College, Notre Dame, Holy Cross, Ind.

Iowa Association of Science Teachers — A. G. Siverson, East High School, Des Moines, Iowa.

Div. of Chem. Educ. of the American Chem. Society — Martin V. McGill, 5439 Kimbark Ave., Chicago, Ill.

Chautauqua County Science Teachers Assn.— Eleonora E. Segerstrom, Jamestown, N. Y.

Associations interested in affiliating with the American Science Teachers Association should write to one of the officers of the association for information. Science teachers may become members directly instead of through some affiliated group. All direct members receive the journal of the association.

A National Membership in **American Science Teachers Association**

Associated with the American Association for the Advancement of Science

Deborah M. Russell, Secretary
State Teachers College, Framinghom, Massachusetts

I desire to become a direct member of (or renew my membership in) the American Science Teachers Association and am enclosing $1.00 in payment of dues.

As a member I understand that I am to receive the following: (1) *The Science Teacher*, the official journal of the association; 2) Reports of association work and other information sent to members of the association; (3) Privilege of attending all the meetings of the association and participating in its work.

NAME .... SCHOOL ADDRESS ....
Street

SCHOOL ....
City State

The Science Teacher

201 North School St.,
Normal - - - - - Illinois

A Service Journal for National, State, and Regional Associations

Official Journal of

Illinois Assn. of Chemistry Teachers
Illinois Biology Teachers Association
Indiana High School Chemistry Teachers Association
Iowa Assn. of Science Teachers, Inc.
Texas Science Teachers Association

Entered as second-class matter January 30, 1940, at the post office at Normal, Illinois, under the Act of March 3, 1879.

SUBSCRIPTION RATES: In the United States, $1.00 per year, or $1.75 for two years; In Canada, 1.25 per year, or $2.00 for two years.

The Science Teacher

VOLUME IX **DECEMBER, 1942** **NUMBER 4**

Youth Needs a New Science

LON EDWARDS

New York University **New York, New York**

I SHALL make little reference to the war we are fighting. We must win it! And of course all our efforts must be directed toward meeting the exigencies of the hour as they arise. But we must also win the peace which will follow. Education will play a vitally important part in winning this peace. For it to play its most effective role, we who are charged with the responsibility of carrying it on, must have clearly in mind just what job we want it to perform. Therefore, much of what I am going to say this afternoon will deal with beliefs about science education. Taken together, these beliefs might be called a philosophy of science teaching, though I hesitate to dignify them to that extent.

Beliefs are important to us as science teachers because they determine what we do in the classroom. If I believe that I should teach my students the results of the scientific thinking of others, my method of teaching will be very different from the one I would use if I believed I should help my students learn how to use the scientific method. Even though the subject matter might be the same, the things done in the classroom would undoubtedly be very different in the two cases.

Beliefs stem from two main sources. Some sources are more or less philosophical, others are more or less factual in nature. Science can discover the truth for us but it cannot tell us what to do with this truth after it is discovered. For example, science can tell us that people suffer certain physical deficiencies if they do not receive certain vitamins in their diet. Whether those vitamins are supplied in the diet depends upon whether it is believed that all people should be as healthy as possible, or that only certain people should be healthy. It is reported that certain vitamins are kept from the conquered people of Europe for the expressed purpose of helping destroy their resistance to the "new order." This is just one of countless illustrations which shows that what we do with facts is often as significant as the facts themselves.

OUR teaching practice is determined by our beliefs, whether stated or implied, and many of our beliefs are philosophical in nature and therefore cannot be subjected to empirical proof. The best that can be done is to establish, as carefully as possible, a set of guiding assumptions which can be accepted, temporarily, as valid. A course of action can then be inferred from them. The course of action will be right if (1) our basic assumptions are sound, and (2) no errors are introduced when we infer the course of action from the assumptions.

One must be continually re-evaluating, modifying, and re-establishing his basic assumptions in light of changes that are constantly occurring. This is a most difficult task. It is one that is never finished. It gives rise to many of the headaches of curriculum revision. But it is a part of such revision that cannot be dispensed with. This is especially true if one accepts the scientific attitude of openmindedness or willingness to change his point of view if new and pertinent evidence is uncovered. Sometimes science

teachers are so dogmatic, so positive in their convictions, so unwilling even to listen to another point of view, that one wonders if there really is an attitude of open-mindedness connected with science training. Perhaps "close-mindedness" is a more accurate term to use.

FOR the next few minutes I should like to propose for your consideration a set of beliefs regarding science education which serve as a basis for inferring the kind of science program which youth now needs. Remember these beliefs are largely philosophical in nature. You may disagree with them as much as you care to. In our society, and the one we are fighting for, that is your privilege. In fact, I might say it is your responsibility. But if you accept the stated assumptions, it seems that you are led to envision, at least in part, the kind of science program which is later briefly proposed.

I. We maintain schools to (1) aid each individual in developing his capabilities to the fullest extent, and (2) to extend democracy as a way of living.

II. These functions will be most effectively performed when each individual.
   - A. Cooperates with others in solving common social problems
   - B. Engages in socially useful work with a high degree of competency
   - C. Acts in a manner consistent with an accurate prediction of the consequences of his acts.

If one accepts these assumptions, it follows that schools must be organized so they help individuals become competent in doing these things in all aspects of their living, both in and out of school.

IF we add one further assumption regarding method of achieving this goal, we have a fairly complete picture of the basis for the entire educational program. It might be stated thus:

I. The competency which individuals develop in school situations transfers to out-of-school situations to the greatest degree when
   - A. The out-of-school situations are recognized by the individual as being similar to the in-school situations where the competency was developed
   - B. The individual makes a conscious effort to use a technic which he thoroughly understands.

If this be true, then school experiences should be organized so they are as nearly identical to out-of-school experiences as possible; the technics used should be understood by the individual students; and he should be so convinced of their worth that he makes a conscious effort to use them.[1]

What does implementation of such a point of view mean for the ecience education program? It would necessitate many changes in classroom practice. I cannot discuss all of them now. I shall point out only two which are almost universally ignored. You can think of others I am sure.

FIRST, science students would cooperate with others in helping solve some common social problems. This means a community science. It means taking the science out of the textbook and the classroom and the laboratory and putting it to work to solve some of the common problems facing either the school community or the larger social community. More specifically it means this. Suppose the biology teacher in the local high school has his students studying insects as a part of their course. Certain insects are studied rather intensively and from this study certain basic generalizations have been formulated. Following this study a more or less theoretical discussion of the application of these ideas to some particular problem is carried on. Often this discussion is planned toward the close of the unit. Time is short. It is hurriedly conducted or omitted entirely. How is this study often carried on?[2] The unfortunate grasshopper is one of the insects often studied. The teacher sends away to a

Review of Ed. Research, October 1933 Vol. III Pg. 294. Monroe Encyclopedia of Educational Research.

[2] Orata, Pedro "Recent Research Studies on Transfer of Training with Implications for the Curriculum, Guidance and Personell Work" *Jour. Ed Research*, Vol. XXXV, (October 1941) No. 2. Pg. 81.

supply house for certain hoppers, has his students carefully study their structure, make nice labelled drawings in their notebooks, place them in the proper class (Insecta) and order (Orthoptra), and pass examinations on this material. Often it happens that the school is located in a community suffering from an overpopulation of hoppers. True, they aren't the nice large ones which can be obtained from a supply house, but they are daily growing larger on the crops the farmers are trying to nurse along. Why couldn't the teacher adapt Biology to the study of hopper control in the local area, encourage students to cooperate with the farmers that are actually trying to control them by actually engaging in the fight, by helping farmers spread poison bait. If it weren't too rank heresay, certain farm boys in the biology class might even go to the industrial arts shop, plan and make bait spreaders, and take them home and use them. Is this too much to hope for? I think not. I just returned from New York City this spring. I was forcefully struck by the inroads the tent caterpillar is making upon the trees in certain sections of the East. Throughout large areas of New York, New Jersey, and Pennsylvania, tree after tree was occupied by the tenting insect. Many trees had been completely destroyed. Then as I rode along I thought of the large number of biology and general science students in the schools in that area. I visualized them poring over books, laboriously labelling drawings, filling out workbooks, passing examinations, and the numerous other minituae that science teachers have them do. I dreamed along. In fancy I saw a class, gleefully, and perhaps a little proudly, troop out of a school armed to the teeth to participate in a "destroy the tenters" campaign. For these students science might become a living experience.

THE biology teachers aren't alone in this respect. I was recently discussing science teaching with a high school principal close to New York City. He felt that his school should offer some work dealing more directly with aviation. So he dropped the hint here and there among his faculty. The idea caught. They are planning to begin some aeronautics courses next fall. Who is teaching them? Not the physics teacher I can assure you. Nor even the general science teacher. An art teacher, whose hobby had been model plane construction, was relieved of half his art teaching load and will teach the course. When I asked the principal why the physics teacher wasn't interested, he smiled and said, in effect, "He's only interested in demonstrating scientific laws with gadgets that look like they belong in another world." True, all science teachers aren't like that, but there are so many of them that something needs to be done. Teachers say they can't teach science the way I am suggesting. The administration will not let them, there isn't time, there are examinations to pass, and so on ad infinitum. Perhaps they can't as present. But unless we bring science out of the books and stuffy classrooms and make it a living thing to our boys and girls and our communities, it will continue to enjoy its steady decline. It will assume a larger and larger proportion of non-importance in the lives of our students. Its vital, living aspects will continue to be absorbed by home economics, social science, physical education, industrial and fine arts. We will have left our test tubes, our laboratories, our fine equipment, and a few more or less "queer" students. The mass of the school population will continue to be without whatever benefits they may have derived from a dynamic, living science experience.

SECONDLY, students must be helped to make intelligent choices of action. Much of a person's living in a democratic society is concerned with choosing courses of action. He must decide if he will buy this commodity or that; will he engage in this type of recreation or none at all; what menu will he select at the restaurant or plan at home; what job can he best do; whom he will vote for and why. These, and a multitude of other choices are constantly being made. Here science may make a great contribution. I say it may, not that it will. Whether it does, is, in a large measure, up to you and me. Those choices of action are wisest when the results from them are consistent with what we thought they would be. We are dismayed, and sometimes

(Continued on Page Thirty-eight)

The Science Teacher and the Victory Corps

EACH science teacher is undoubtedly anxious to know specifically what he can do in hastening the victory that must be ours. He wants to know what the armed forces desire and he wants to know what other teachers are doing.

In the high school the teacher is now faced with the problem of providing the terminal school training for boys before their induction into the army. So it is imperative that a maximum of help be given them here if they are to be of greatest service. A knowledge of what the soldier should know is needed.

Since the training of men has begun in mass the army has been short of skilled personnel in many areas. Out of every 100,000 men 6300 were needed with some sort of technical training, but there was a shortage of such men. Of the 1400 medical technicians needed, the army got 166. Instead of getting 1457 telegraph line men, it got 114. Further, the army found that too small a percentage possessed an adequate understanding of science principles to be quickly trained for the technical positions that must be filled.

Whatever the reason for a deficiency in science training in our educational system, we must do what we can now to meet the need. Specific learning elements are needed. These have been outlined quite well in the Victory Corps booklets being distributed among the schools. Science courses can easily stress the features most needed.

AS to how the Victory Corps program should be handled depends upon the organization of the school and its size. It would not be desirable to change the school program to an extent that would interfere with the smooth operation of the school. Such a change would result in disorganization and reduce effective learning. With the larger schools it would be possible to organize new special courses for giving pre-induction training. But for many schools the establishment of new special courses would not be desirable where teachers are not well suited to it, as such change would result in wasted effort and inefficiency.

Then what should be done? In all schools the learning elements most needed, as indicated by the military forces, can be stressed in the courses already being taught. A new emphasis can be given them and they can be taught in terms of military applications.

(Continued on Page Thirty-nine)

OUR FRONTISPIECE

For our frontispiece we are indebted to Miss Illa Podendorf of Newton High School, Newton, Iowa. It repersents a photomicrograph of a feather of an oriole's wing.

A. S. T. A. MEETING

Final arrangements for the annual meeting of the American Science Teachers Association have been completed and a good attendance is expected. The meeting will be in the Hotel Pennsylvania, New York City, December 30 as announced by Dr. Hugh C. Muldoon of Duquesne University, first Vice President of the association.

The program; as announced by Dr. Muldoon, deals with two important aspects of current problems of science teachers. In the morning the problem considered is *Science Teaching in War Time*, while in the afternoon it is *Curricular Problems*.

Many of the people appearing on the program are nationally known and are people that teachers will want to meet and hear. All science teachers are invited, whether members of the association or not. For the complete program see the October issue of *The Science Teacher*.

All science teachers associations are encouraged to send representatives.

The American Science Teachers Association and the Work of Harry A. Carpenter

FEW MEN of today have more influenced the organized activities of national science teacher groups, as well as state groups, than has the late Harry A. Carpenter, Specialist in Science of the Rochester Public Schools of New York State, and one of of the organizers of the American Science Teachers Association. Records show that he was actively connected with most of the organizations in this field, usually as an active worker and often as an officer in a position to help shape the policies of the organization. But it is as an organizer of science teacher groups and as a leader in the establishment of plans of cooperative effort that we want to give him special attention.

When the National Association for Research in Science Teaching was first established, we find that Mr. Carpenter was among the group that organized and started it well on its way of active service. He was a member of its executive committee and in 1940 was its president. The good work of this association reflects much credit to Dr. Carpenter as well as to the others who had the vision to establish it..

Other groups were organized in which he had an important part, but it was to the organization of the American Science Teachers Association that he probably gave the most thought and effort.

Along with other national leaders in the field of science education, including Dr. Otis Caldwell, now permanent secretary of American Association for the Advancement of Science, Mr. Carpenter had the vision of doing more for science teachers and science education by means of a national organization through which the many state and regional science teacher groups could cooperate in working toward a common goal. As a result the American Science Teachers Association was formed and has since grown to serve a very large number of associations throughout the United States. Mr. Carpenter, a zealous and energetic worker in its organization, became its first president in 1933 and retained that position until 1939. Since that date he has served as a director of the organization.

From the facts we have just noted it is easy to see that much of the growth and usefulness of the association is due to the efforts of Mr. Carpenter. A brief sketch of its development will serve to give some insight into his ideals, ambitions, and his efforts to cooperate with his fellows.

The American Science Teachers Association did not spring up in a brief period as a result of a short-lived effort. Instead it developed slowly after much exploration among science teachers in the field. Those who were actively teaching science twelve or fifteen years ago may recall receiving mimeograph letters from Mr. Carpenter again and again as ideas were collected, plans were sent out and teacher reactions received. When the field seemed to be fully explored, the date for final establishment of the association was extended still another year with the thought that a better organization that might more fully meet science teacher needs could be established. This indicates the careful work that Mr. Carpenter and his colleagues did.

FINALLY in the formation of plans it was decided to affiliate the group with the American Association for the Advancement of Science as a means of tieing together more closely those who were active in pure science and those who must teach it. It was hoped that the contact would be mutually beneficial to the two groups. And so it has been.

As a result of careful planning and cooperative effort the American Science Teachers Assoiation has developed rapidly and now occupies a place of influence in shaping and initiating educational policies and through its journal is serving as a clearing house for useful information as was originally intended by Mr. Carpenter and his fellow workers in the field of science education.

Our Opportunity

JACK HUDSPETH Retiring President

Dept. of Science Instruction, N. E. A. Austin, Texas

THE present struggle, which is demanding the utmost of our nation's capacity to produce and to make administrative decisions, is revealing certain long-standing deficiencies in our public schools. Spokesmen in industry and in the armed forces tell us that most of the young men who have been sent to them are handicapped by their inability to read with understanding, do arithmetic problems, and spell and by their lack of knowledge about their surroundings and common materials and machines and the principles that underlie their use. There is nothing inherently wrong with these young people; they are healthy, intelligent, and alert. But they have been deprived of a deservedly adequate education as they went through the public schools. Their training in industry and in the armed forces is having to be greatly lengenthened because of their educational deficiencies.

We know why their schooling has been deficient. Although the curriculum has been revised continuously during the past fifteen years, its basic character has changed little. During this time science has made great strides and the discoveries have found their way into every branch of industry and the life of the American citizen. It is not impossible to work and enjoy life in this nation without associating closely with science and the products of science. Yet science in our schools has a relatively unimportant place in the curriculum. The average American child gets little instruction in science until he reaches the ninth grade, and then a foreign language, public speaking, music, or art may crowd science out of his program. Only a small percentage of students take any high school science except biology.

SMALL wonder is it then that our high school graduates seem ignorant to the leaders in industry and the armed forces. Small wonder is it that the gap is ever widening between industry (and science) and the average citizen.

There is much talk of correcting this situation, and it seems that it must be corrected. Apparently if we are ever to win this war, most of the work must be done by highly skilled young men and women, and after that will come a long period of reorganization and rebuilding which we hope will be done largely by trained young people. Pressure is being brought on the schools for a wholesale reorganization in the light of the urgent demands by industry and the armed forces (which, fortunately, are identical). This means that science instruction has a good chance of finally getting the status in the curriculum in all grades that it deserves. A comparatively small group of foresighted educators has for years been pointing out the essential contribution of science in all grades of the public schools, and it now appears that the advice of that group is to be heeded, somewhat belatedly, but not irreparably so.

Of course this calls for some joy, but far more work than joy is now needed among the promoters of science instruction. Many problems still need to be solved and essenital truths to be determined if science instruction is to justify a prominent position in all grades of the public schools.

For instance, more information is needed on the specific outcomes that can be achieved in each grade level by science teaching. Fortunately a subcommittee of the National Committee on Science Teaching, working under the able direction of W. C. Croxton, has just completed a three-year study of this problem and issued a report containing specific findings for each grade level. But this is not the final word on the subject; much more work is needed.

(Continued on Page Forty-two)

A Work Program for Teachers of Science

J. E. WERT*

Iowa State College Ames, Iowa

FOR several months we have heard the slogan "All-out effort for national defense." There seems to be some tendency at the present time to modify that slogan to "All-out effort for national offense." Newspaper and magazine accounts have assisted in indicating in a broad, general way the role which science must play in this "all-out effort." However, the details by which the science teacher may play his important part are, as yet, not clear.

I am not at all certain how much useful information from World War I is applicable to World War II. That the tempo of modern warfare has been stepped up tremendously, none can deny. Even the relative effectiveness of the various branches of service has changed, as indicated by Hanson W. Baldwin, a war analyst for the New York *Times,* in the current issue of the *Saturday Evening Post.* Yet we do know that the production of steel, along with other needed war materials, is an even more important factor in the present war than it was a quarter of a century ago.

FOR a moment I would like to limit my remarks to the field of chemistry and what high school teachers might be doing to answer demands which, judging from the last war, would be useful in the steel industry.

No one doubts the urgent demand for highly trained technical chemists, and, no doubt, one function of the high school chemistry teacher is to provide the type of high school experiences which would enable the student to undertake specialized training in a technical institution. Yet, as you all are aware, many students have neither the capacity nor the interest to undertake such specialization. Furthermore, there is also demand in chemical laboratories for men to run routine analysis, usually of one single chemical element such as manganese or silica in steel or pig iron. While it may be possible during peace time for positions of this type to be filled with technically-trained men, in war time recourse must be had to men with less training. Might it not be possible in connection with a high school course in chemistry, either as a curricular or extracurricular activity, to provide immediate short-time training for making routine analysis?

NATURALLY it is not to be expected that the high school will be able to train pupils for general analytical work nor for making the standard solutions necessary in volumetric analyses. On the other hand, no technical knowledge of chemistry is necessary in order to run an analysis by titration if the standard solutions are already available. Thus it is possible in many laboratories to so plan the activities that few technically-trained chemists are essential.

In World War I it would have been extremely helpful if we in the laboratories could have been saved the time and effort that were necessary for training young men for these routine jobs.

Although of recent years I have not followed curriculum development in the field of chemistry, I am sure that at the time of World War I the content of chemistry courses was not designed for the training of routine workers. In fact, the high school chemistry course was not conceived as an "end" course, but rather as a beginning for those pupils who would enter the colleges and technical schools. Practically no attention was paid at that time to any quantitative analysis. Rather, the emphasis seemed to be on the more elusive concepts of technical chemistry which, from the standpoint of the war effort, could have been legitimately postponed. The example cited here in chemistry may be paralleled in any of the other fields of science.

My first proposal, then, is that science teachers attempt to reevaluate the science

(Continued on Page Forty-six)

* Director of the Summer Quarter, Iowa State College.

* Prepared for the Iowa Association of Science Teachers, February 28, 1942, by James E. Wert.

The Metals as Vital War Materials

B. S. HOPKINS

University of Illinois **Urbana, Illinois**

(Continued from October Issue)

WE SHALL NOW turn our attention to some other essential metals whose supply is somewhat uncertain. There are at least four common metals which are required in considerable tonnage for which we are largely dependent upon foreign supplies. These are chromium, manganese, nickel and tin. We produce about 3% of the world's chromium and less than 1% of each of the other three.

The largest producers of chromium are Russia, Turkey and Rhodesia. The steel industry consumes from 75 to 90% of the ore, either as a refractory or in making alloy steel. Stainless steel so popular in recent years requires large percentages of chromium, and chrome plated plumbing fixtures and automobile parts have been very popular. For most uses a high grade ore is required, and the American ores are low-grade. Our Government has been accumulating a sizeable stock pile and it seems likely that careful use of the material on hand will meet our needs until our domestic supply can be increased.

MANGANESE, almost essential in the production of any type of high grade steel, occupies an economic position very similar to that of chromium. It has come almost entirely from Asiatic and European sources which are not now available. Domestic production, all of relatively low grade, has accounted for only about 0.5% of the world's supply. There are however two encouraging facts which may be recorded: (1) considerable stock piles have been accumulated and (2) the U. S. Bureau of Mines has recently announced a method of concentration which can be applied to American ores by which they are enriched and are thus able to meet the most exacting requirements of the steel trade. As a result of these facts there is little apprehension regarding our supply of manganese.

About 85% of the world's nickel comes from the Sudbury district in Ontario. Our own production is negligible, amounting to only about 0.3% of the world's supply. This metal is used in making alloy steels and innumerable alloys, to which nickel imparts, in large measure, its own desirable properties. The demand for nickel has increased rapidly during normal years, as is shown by the fact that the domestic consumption in 1939 showed an increase of 136% over that of 1938. The war situation has emphasized this increasing need for nickel, but in spite of this fact there has been almost no change in the price of the metal since 1926. From this fact we may conclude that there is no great fear of a nickel shortage, although of course economy of use is necessary.

THE most serious metal shortage which we face is tin. In normal times 71% of the world's supply came from Malaya and neighboring islands, 17% from South America and 10% from Africa. An effort was made to build up a reserve supply of tin (but it was not strikingly successful. Efforts are now being made to enlarge the receipts from South America and it is likely that some success in this direction may be accomplished, but the best we can hope for under present prospects is that the supply from allsources will not exceed one-quarter of our normal peace-time requirements. As a result there is now great empasis being placed on the recovery of tin from scrap as well as on the strictest economy in the use of the metal. Recovery from manufacturing scrap is now quite complete, but recovery from used tin cans is still expensive and difficult. A very excellent way for patriotic citizens to help in meeting the keen tin shortage is to save the metal from collapsible tubes such as those used for toothpaste, shaving cream and library paste. This meal is usually pure tin of immediate reuse. In spite of every effort in this direction

however, we are certain to meet serious conditions resulting from the shortage of tin.

In addition to these 11 metals which are familiar in commercial circles there are several others, which are not so widely known, that are rather scarce and yet are essential as war materials. One of the most interesting of these is cadmium. This is a metal which is closely associated with zinc. Preceding World War I there was little use for cadmium, and the refiners of zinc did not take the trouble to remove cadmium from the metal they sold. For some uses the presence of cadmium was objectionable because when present in considerable quantities it discolored the zinc compounds. As a result there sprang up a demand for zinc which was cadmium free and a higher price was paid for such metal. Producers found that it was profitable to remove the cadmium in order to secure the higher price for zinc. Having quantities of cadmium material on hand it was perfectly natural that attempts should be made to find uses for it. It soon found extensive uses as an anti-corrosion coating on iron and steel products. Later it became popular in many alloys for a variety of purposes; its greatest popularity was as a component of bearing metals. Its usefulness gave it a meteoric career and the price rose sharply. Accumulated dusts and residues were worked over for their cadmium content. These sources have now been exhausted, so the present supply of cadmium is largely dependent upon the demand for zinc. This situation has made it necessary to put cadmium on the priority list of essential materials, which can no longer be used in civilian industries.

ANTIMONY is another strategic metal for which we are almost wholly dependent upon foreign supplies. Our usual production amounts to about 1% of the world's supply while we consume approximately one-third of all the world can produce. The world's biggest producers have been China, Mexico, Bolivia, Yugoslavia and Algeria. In recent years Canada, Mexico and Bolivia have greatly increased their output, so now it seems that our supply of antimony is not a cause for immediate alarm, altho the wide variety of its uses will require careful conservation of the metal. There are no satisfactory substitutes for antimony in such alloys as hard lead for shrapnel, battery plates, antifriction bearing metals, linotype metal, pewter and Brittania metal. The compounds of antimony are likewise almost indespensible for the manufacture of safety matches, rubber goods, enamels, porcelain, Bengal fires and primers for cartridges.

Iridium is a member of the platinum group of metals. It is characterized by its permanence and marked influence upon its alloys. Usual commercial platinum contains about 3% of iridium which increases the life of the metal. Iridium is very essential in the manufacture of surgical instruments, hypodermic needles, rayon spinneretts, fountain pen points, watch and compass bearings and many scientific instruments. Because of the important uses for iridium, its scarcity and difficulty in its purification the price of this metal will usually be about 3 to 4 times that of an equal weight of platinum or 5 to 7 times its weight in gold. At the present time the supply of iridium is much more critical than that of platinum and it will be remembered that in 1914-18 the inadequate supply of platinum was one of the most serious obstacles in the national program of defense.

THE United States has been the World's largest consumer of tungsten. In years gone by most of our supply has come from China, Burma, Korea and Malaya. Most fortunately for us in the present crisis the importance of tungsten was recognized in 1914-18 and steps were taken to develop the domestic supplies, which come mainly from California and Colorado. As a result the United States is now one of the leading producers of tungsten, altho the demand is large and economy of use is necessary. We are most familiar with tungsten as contact points in spark plugs and in our electric lamps, but the quantity used for these purposes is quite insignificant, as compared to the amount employed for the manufacture of high speed steel. This form of steel makes it possible for machine shops to multiply the volume of their production from 3 to 6 fold because the shaping of the product can be done so

(Continued on Page Thirty-six)

Relative Activity of the Halogens

M. J. PHILLIPS

West Allis High School West Allis, Wisconsin

CHLORINE, bromine, and iodine may be prepared at the same time with this demonstration. The apparatus, as shown in the photograph, Fig. 1, and in the drawing, Fig. II, is simple and easy to assembly. The chlorine is generated in the usual manner, in a gas generator with hydrochloric acid and manganese dioxide. If the generator is placed in a pan of water to hold down the heat, the flow of the chlorine from the generator can be more easily controlled.

The chlorine gas is directed through a bottle of saturated sodium chloride solution; this is used to indicate the flow of chlorine gas as it is generated. For this demonstration the equipment consists of a rather large glass tube, about three feet long and one inch in diameter. Inside this tube at a point separating I from II as indicated in Fig. II, is placed glasswool containing moistened potassium bromide. Again, at a point separating II from III as shown in the drawing is glasswool containing moistened potassium iodide.

THE equipment is placed in operation. Chlorine is in section I. In the moistened glasswool the chlorine reacts with the potassium bromide, releasing bromine, in section II of the tube. The bromine then comes in contact with potassium iodide, releasing iodine in section III. This portion of the tube is gently heated to vaporize the iodine in section III.

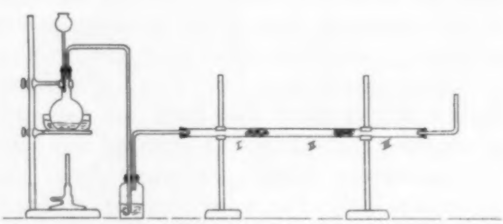
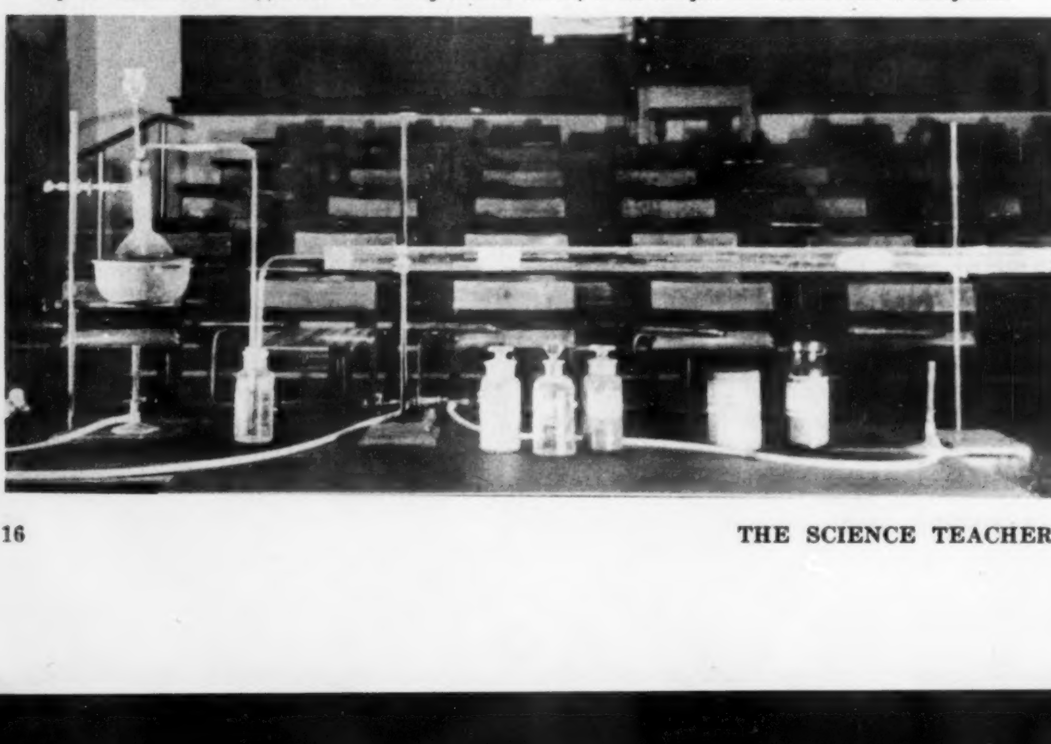


Fig. 2. Arrangement of apparatus for showing activity of the halogens.

In this demonstration, the pupil is able to see chlorine in section I, bromine in section II and iodine in section III — all at the same time. Thus the order of stability of the halogens is demonstrated. The relative density is shown by the fact that chlorine, the least dense exists as a greenish yellow gas; bromine, the next dense, as a red liquid; and iodine, the most dense, as a solid. By using the heat of the bunsen burner, the solid iodine is vaporized and appears as a violet vapor. The order of appearance in the tube is as their atomic weights. Chlorine, atomic

(Continued on Page Thirty-three)

Fig. 1. Demonstration apparatus for showing relative activity of the halogens with lecture room in background.



EDITED BY JOSEPH SINGERMAN

● A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

The Science of Pre-flight Aeronautics

PAUL R. MORT*

Teachers College, Columbia University New York, New York

IN war or peace, we fly or die. The challenging truth of this statement cannot but be driven home to one who looks at the new maps that the age of air has created for us. Canada and Mexico are like broad beaches on our nothern and southern borders. The oceans have narrowed. Darkest Africa has become a pathway to Asia and Eastern Europe. Our ramparts reach from the Aleutians to Australia. Tens of thousands of planes now built for war will be the successors to the few hundred transports of a scant two years ago. To other lands, in peace, we will be close bound like the nations of pre-war Europe. The students now in our schools will be the backbone of the air force that must assure the winning of the war, and the backlog of trained personnel to maintain our place after the victory.

Because of the very limitations of the human body in high flight and in rapid change in flight direction, the crews of the fighter and bomber planes, now being built in large numbers, must draw heavily upon our youthful population. The boys now in high school will be fliers out of proportion to their numbers.

Two Groups Face the Issue

THESE are the essential facts in barest outline that lay back of the interest of the group, drawn together as an advisory committee on education by the Civil Aeronautics Administration to protect the work, already well developed by that agency in the College Civilian Pilot Training Program. They are the facts that caused a group of persons who had seen what had been done with boys of high school age in England and Canada to band themselves together as the Air Training Corps of America, that they might assist in helping to give similar preparation to American boys for the fateful task that lay inexorably before them.

The two groups moved into this field quite independently. The Civil Aeronautics Administration encouraged the educational advisory committee to project a program covering not only the ground school part of the training of air crews, but also the general conditioning of pupils throughout the grades of elementary and secondary schools, to live in a three dimensional world. A program, first projected late in December 1941, was under consideration by the authorities in Washington when the Air Training Corps of America Incorporated was organized as a voluntary non-profit corporation to work to develop as extensive a program in the fre-flight field as possible.

ATCA Leads Out

THE Air Training Corps envisioned not only training in the science of aeronautics, but also military orientation, guidance, physical conditioning, medical examination, the correction of remediable defects and testing of achievement. The present writer was detailed to enlist a group of schools in carrying out an appraisal and development project during the spring of 1942. About the middle of February the problem was put to a group of school superintendents from New York City and surrounding school systems. Their interest in undertaking the task of preparing materials that could be used by the schools throughout the nation was most encouraging.

* Professor of Education, Teachers College, Columbia University.

As a result, all interested were invited to send representatives to a meeting called a short time later. Certain other schools were invited so as to assure representatives from all types of high schools. The group took up the work energetically. In less than a month a survey had been made of all books and syllabi available and, with the assistance of representatives of the Assistant Secretary of War for Air and the Assistant Secretary of the Navy for Air, the detailed subjects to be treated in the fields of aerodynamics, structure, engines, navigation, meteorology, safety and communications were selected. The next step was to assign each subject to from three to seven schools for the actual instruction of boys to that available instructional material could be appraised in actual practice, and so that a basis could be laid for the preparation of new materials where needed. At the same time the men directing work in these schools went to work as a committee to prepare manuals on guidance and administration. With the help of army representatives, a preliminary manual on military training and orientation was developed, and the services of physical education specialists were obtained to develop a manual in physical training and forms for medical examination.

Responsibility Re-allocated

THE work was only well begun when the authorities in Washington obtained funds to carry out, in considerable part, the program prepared by the advisory committee's sub-committee on research. After the work on general air conditioning had got under way under Dr. Engelhardt's direction, and the series of field conferences had been launched under the leadership of Dr. Ben D. Wood, the authorities in Washington arranged to take over the science of aeronautics phase of the development program outlined above. The central staff working on this phase of the program was shifted from the auspices of the Air Training Corps to those of the Civil Aeronautics Administration Aviation Education Research Project. In spite of the shift, the two parts of the pre-flight program were carried on by the group of cooperating schools working as a unit. The actual classroom instruction in the science of aeronautics together with the appraisal of existing materials, and finally, the preparation of new materials, was carried on by the teachers of these subjects working with the Aviation Education Research Staff. Meanwhile, the materials on administration, testing and guidance, and the work in military training, physical education and medical examination was carried forward by the local directors, instructors in military training and the central staff of the Air Training Corps Research Project.

Naturally, in between the work in the schools and in the general administration of the two research projects there was necessarily a great deal of interplay. Those concerned with the work were interested in what could be done to help American boys face the inevitable and inescapable task before them rather than in the exact source of the funds that went to pay for their materials or for the assistance of the central staff.

The Cooperating Schools

TWELVE schools, public, private and parochial, made up the group that undertook the task of appraising existing materials and developing needed materials. These schools were:

- New York Public Schools: The Bronx High School of Science, the Haaren High School Aviation Annex, Brooklyn High School of Automotive Trades, and the Eastern District High School of Brooklyn
- New Rochelle Public Schools: All three high schools
- The Farmingdale High School, Long Island
- The Sewanhaka High School, Long Island
- The Cardinal Hayes High School, New York City
- The Hackley School, Tarrytown, New York
- The Horace Mann School for Boys, New York City.

Where, as in most cases, some one was given a special assignment to direct this work in a school or school system, the Superintendent or Head of the school also participated extensively.

The Science of Aeronautics

AT the first meetings dealing with subject matter, held early in March, those selected to direct the program in the various schools were presented with a detailed analysis of the contents of the longer and shorter manuals of the Civil Aeronautics Authority, the most inclusive commercial texts in the field, and the Canadian Air Cadet manuals. After the scope of the subject matter had been determined and tentative time allotments made to the various subdivisions, the schools selected the topics on which they were to work and went about the organization of classes. The teachers in the various schools assigned to each topic were formed into a committee which planned the procedure in detail. The central office made available texts, film slides, moving pictures, charts and other available instruction material. Each committee met at least once a week with a coordinating officer from the central office staff as the project proceeded. They worked together nights, Saturdays, Sundays and holidays. In the early meetings when the subject matter was selected, the realization that these boys with whom they were working were but a short way removed from the great adventure made the group impatient with many of the issues that arise when a new subject is under consideration. This was not just a new subject. This was an effort to give these boys whatever would promise to make them better fliers. Nothing was done because it was thought "a nice thing to do"; nothing was included that was just something that might be "nice for a flier to know." The test of utility was ever present. There was a feeling that good decisions might save thousands of lives; inadequate decisions might mean that many boys would not come home again.

By this process materials were tried out, new materials were written, boys' problems of learning were noted; ways of bridging inadequacies in past mathematical or scientific training were bridged. In this setting it was not difficult for these men to come to the conclusion that if the resulting materials took a year and a half for mastery, that not less than one and one-half years should be allowed. In this spirit the issues of how much mathematics should be required or whether the emphasis should be physics or aeronautics were quickly resolved. The answer to the one was that there should be no mathematics drawn in for the sake of teaching mathematics; and where procedure could be developed by simpler graphing methods these procedures should be taught. The answer to the other was that what proved to be three semester's of work could hardly be infused into a traditional one year physics course.

FINALLY, from each group* one or two men were selected for final preparation of the text of new materials and these men were relieved by their schools to carry through this final task. All of the seven texts were edited by Dr. H. Emmett Brown of the Lincoln School, and Dr. Ralph Horton, the director of the New York City project. The final texts were submitted to outstanding subject matter experts for subject matter authentication before they were turned over to the Civil

* These groups were as follows: *Airplane Structures*: Alexander Joseph, Bronx High School of Science, New York City, Earl Brownell of the Isaac E. Young High School at New Rochelle, New York, E. D. Perkins, Aviation Annex of the Haaren High School, New York City; *Human Factors in Flight*: Ralph E. Horton, New York City School System, Frederick L. Lobdell, of the New Rochelle School System; *Aerodynamics*: Alexander Joseph, Bronx High School of Science, New York City, Brother Gery of the Cardinal Hayes High School, New York City, Paul Kaye of the Bronx High School of Science, William F. LeSeur, Brooklyn High School of Automotive Trades, C. R. Salit, Sewanhaka High School, Floral Park, New York, Walter Wachter of the Eastern District High School, Brooklyn, New York; *Airplane Engines*: Ernest D. Perkins Haaren Aviation Annex High School, New York City, Walter Jankowski, Sewanhaka High School, Floral Park, Long Island, Walter Anderson, Farmingdale Public Schools, Farmingdale, Long Island, H. J. Lockhart, Farmingdale Public Schools, Farmingdale, Long Island; *Meteorology*: Harry H. Williams, Horace Mann School for Boys, New York City, Brother Eymard, Cardinal Hayes High School, New York City, Wallalce Purdy, Sewanhake High School, Floral Park, Long Island; *Communications*: E. E. Eberle of the Sewanhaka High School, Floral Park, New York, William Koster of the Farmingdale High School, Farmingdale, New York, Arthur B. Hussey, New Rochelle High School, New Rochelle, New York, Lester B. Emerson, Albert Leonard High School, New Rochelle, New York, Harry M. Cook, Hackley School, Tarrytown, New York, Victor L. Miller of the Bethpage School, Farmingdale, New York; *Air Navigation*: S. L. Greitzer, Bronx High School of Science, New York City, George P. Howard, Hackley School, Tarrytown, New York, T. J. Kalligan and D. N. Moore of the Horace Mann School for Boys, New York City, Brother Vincent and Brother Zenon of the Cardinal Hayes High School, New York City. The local directors participating in the project were: Mr. Alfred Baruth, Horace Mann School for Boys, New York City; Mr. John Chisholm, Farmingdale Schools, Farmingdale, L. I.; Dr. Herbert Clish, New Rochelle, N. Y.; Brother Nathaniel, Cardinal Haves High School, New York City; Mr. Howard Nordahl, Sewanhaka High School Floral Park, L. I., Mr. S. J. Smith, New Rochelle Schools, New Rochelle, New York.

(Continued on Page Thirty-seven)

Some Insect Friends of Man

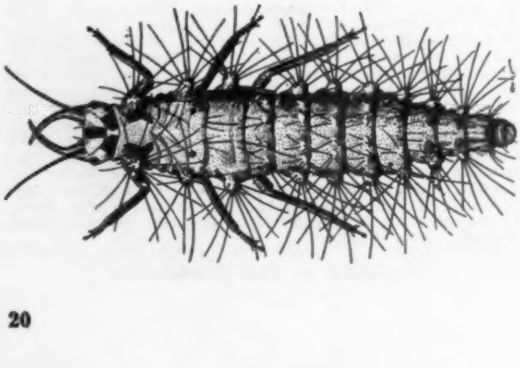
LEE H. TOWNSEND

University of Kentucky Lexington, Kentucky

APHIS-LIONS or Chrysopidae: The adults of the aphis lions are known as lace wings and are familiar to some people since they are often found on herbage and upon the foliage of trees and shrubs during the summer months. Some of these are attracted to lights and gain entrance to our homes on summer evenings. These adults (Fig. 5) are easily recognized by their delicate lace-like wings and their green or yellowish green color. They may be referred to as golden-eyed flies on account of the metallic color of their eyes in life. These adults have little importance to man. They have the same type of development as the two groups already described.

The larvae af these insects feed largely upon aphids but they may also attack thrips, mealybugs, scale insects, red spiders, and the eggs of various insects. These larvae (Fig. 4) are long-bodied, thickest in the middle section, and bear very long, sickle-shaped mouthparts by means of which they seize and drain the body contents of their prey. These mouthparts are hollow and form two closed tubes through which the juices of the victim are sucked into the mouth. These spindle-shaped larvae are very aggressive in attack which characteristic has given them the name "aphis-lions." Approximately 16 days are required for these larva to grow-up and during this time each larva may consume from 300 to 400 aphids.

Fig. 4. An aphis lion. (Courtesy of Illinois State Natural History Survey.)



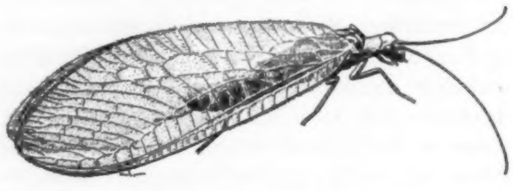


Fig. 5. A lace wing. (Courtesy Illinois State Natural History Survey.)

WHEN the larva is full-grown it settles down on a leaf closeby and after spinning a cocoon, goes into the pupal or resting stage. This stage averages 14 to 18 days usually and the adult insect appears having cut its way out of the cocoon through a circular lid. After a few minutes have been allowed for the body to harden, and the wings to expand and dry the lacewing is ready for flight.

Egg-laying begins very soon in adult life. These eggs are curious objects, each white egg being placed on a long slender stem high above the surface to which they are attached. These slender stems with an egg on the upper end are often found on the leaves or stems of trees, vegetables, or field crops. This peculiar arrangement protects the small larvae from each other when they hatch.

These larvae can be found in an aphid colony by some careful searching and may be reared to the adult in the same manner as the flower-fly or ladybird beetle. Only one larva should be kept in each dish or container for they may feed on each other.

MANY OF OUR injurious insects are attacked by internal parasites or some small wasp or fly which develops within the body. The various kinds of aphids are attacked in large numbers by minute wasps which develop inside the aphid's body. Some of these aphids which occur in great numbers and do much damage when attacked by parasites under favorable conditions may be so greatly reduced that no further damage is inflicted.

A common paraside of aphids (Fig. 6) deposits its egg within the body of the aphid

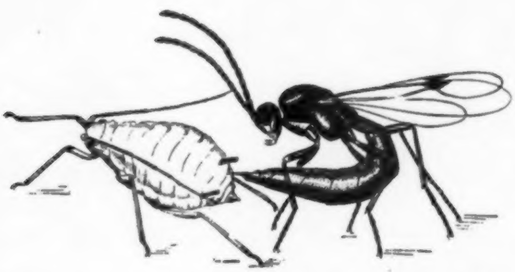
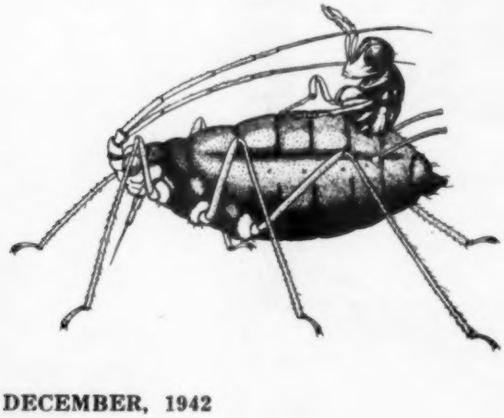


Fig. 6. An aphid parasite stinging an aphid. (After Circ. 346, U. S. D. A.)

as shown in the figure. Very soon this egg hatches into a very small, footless, white grub or worm which lives in the body of the aphid or host. The body contents of these parasitized aphids are entirely consumed by the little worm, and the aphid's body assumes a characteristic mumified condition and adheres to the leaf surface. These remains may at times be seen in enormous numbers upon the plant; in fact, in greater numbers than the healthy individuals. After the worm is full grown the hollow aphids's body furnishes a place for the pupal stage of the wasp. Finally the adulp wasp emerges (Fig. 7) from the old parasitized aphid's body. From the time the wasp deposits its egg within the body of the aphid until the adult wasp emerges requires about 10 days. Remembering this and also that each adult parasite may attack a total of 100 aphids, we can understand how the parasite may increase very rapidly under favorable conditions.

ALMOST any cabbage plant infested with aphids will show individuals which have lost their normal green appearance and have become a yellowish-brown. Closer examination will reveal that many of these discolored aphids have neat circular holes cut in their backs through which a parasite has emerged. If one of these plants so infested is transplanted to a pot or box and brought inside one may watch these parasites and see how the number of aphids becomes smaller and smaller. This is a way to really see parasites at work.

Fig. 7. A parasite emerging from an aphid. (After Griswold Anns. Ent. Soc. Amer. 1929.)



Very often we may see specimens of the tobacco or tomato hornworms whose backs are covered with small, elongate, white objects glued by one end to the back of the caterpillar. All too frequently these are called "eggs" and are seldom understood. They are not "eggs" but are silken cocoons enclosing the pupal stage of a small wasp. The adult wasp had previously deposited many eggs through the skin of the caterpillar. The larvae or worms which had hatched from these eggs

(Continued on Page Thirty-five)

Fig. 8. A parasite attacking an insect egg. (After Circ. 346, U. S. D. A.)

Solving the Animal Cage Problem

FERNE KRATZER

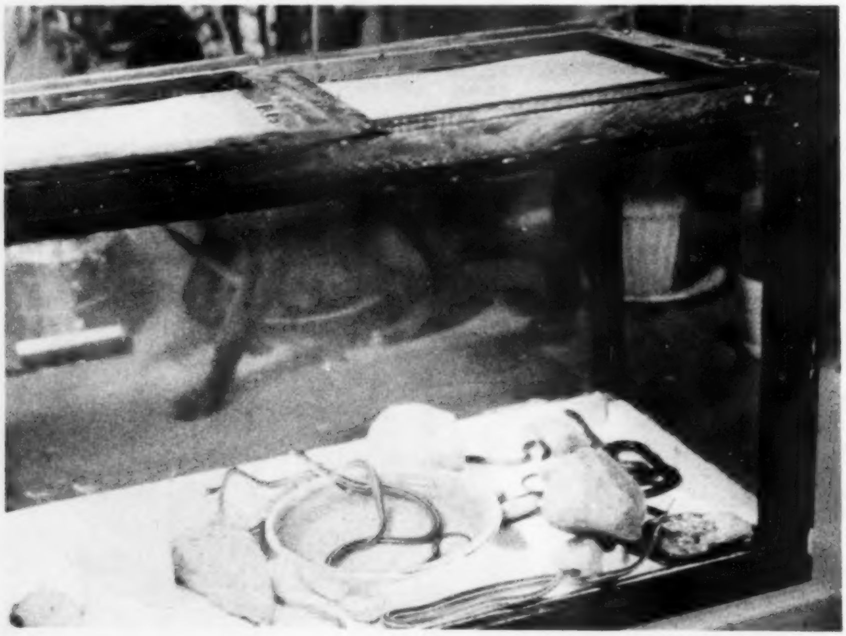
Washington Grade School **Newton, Iowa**

THERE MAY BE others connected with science work who have felt a need for cages for live animals in the room where they can be as comfortable as possible and be observed with safety. It was certainly one of mine.

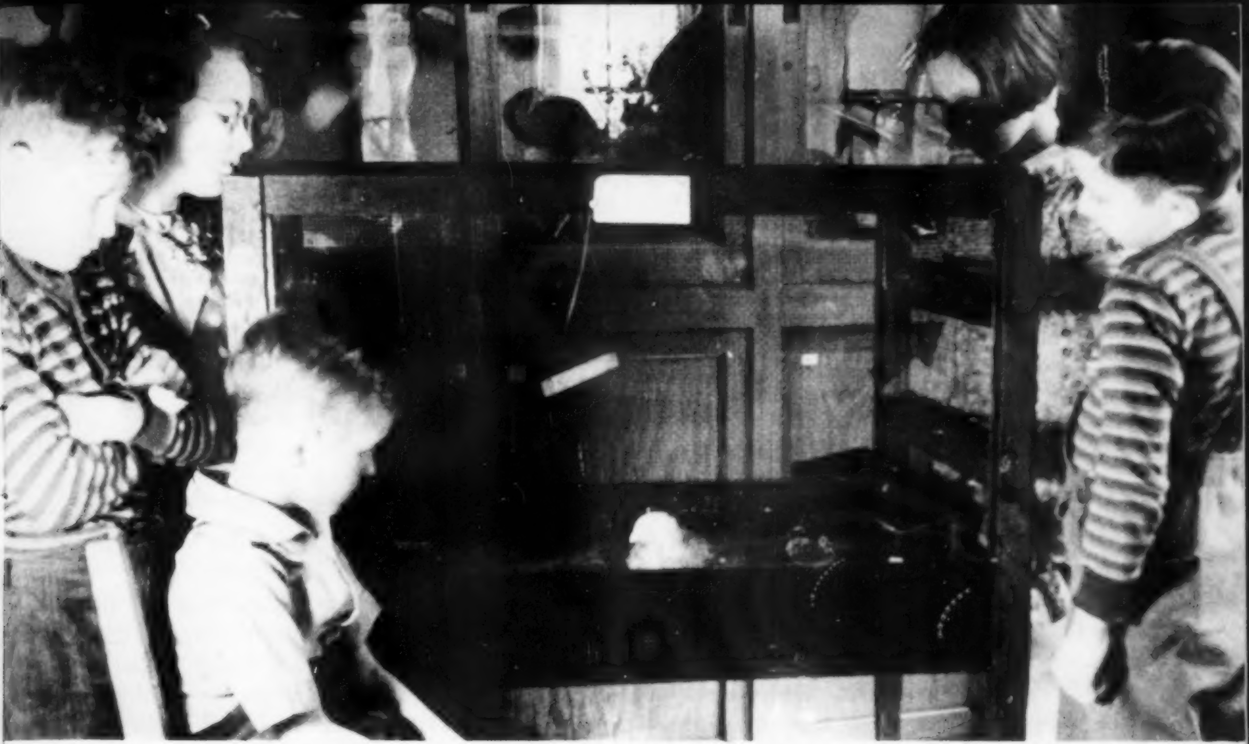
I shall never forget that evening early in my career as an elementary science teacher. Someone had brought a three-foot bull snake to school and there was no place for him, except a box which was about sixteen inches deep, twelve inches wide, and not two feet long. It was about half filled with soil to bring the animal nearer the screen wire top for observation. However, not more than three persons could get their noses near the screen wire at once, and that was the only way to see inside the box. With a class of thirty or forty inquisitive children, the results were anything but satisfactory! That evening after everyone had gone, the snake decided to go exploring. I don't remember about getting him back in that box, but I began to plan a container which would keep any animal where I wanted it. The snake was returned to his natural environment as soon as possible. I couldn't blame him for disliking such cramped quarters.

NEXT ON our list were some flat, wide galvanized pans with screen wire covers — and more troubles. These pans were about three feet high and the covers were not fastened anywhere. The smaller children usually boosted themselves up by their elbows and the boosts often carried them too far. If they couldn't see by that method, they raised the covers, which were invariably left askew. The result was escaped snakes. One snake eluded our efforts to capture him and disappeared down a hole beside a water-pipe. We never saw nor heard of him again. We didn't detect any tell-tale odors, so I suppose he found an outlet somewhere.

Not so long ago, Lew and Elmer Johnson from Ashland, Wisconsin brought their snake collection to Newton. It was wonderful, and I was fascinated by their equipment. Their



A cage found suitable for snakes. It has one side made of glass and the three other sides covered with wire cloth.



An inexpensive animal cage that is attractive and well arranged. Note that one side is of glass to safeguard children.

cages were so easily cleaned and so sanitary. They emphasized sanitation as well as comfort. All this and more is explained in their book, "'Snakes and Spiders — How to Catch, Tame, and Keep Them."

Our large animal cages were a problem, too. Some were practically useless, as they were so shallow and had only one door at the end. We had some ground squirrels in one, any every time we tried to put in water, they got out. Of course, it was impossible to clean the cages while they were inside.

SOME TIME AGO, our superintendent told us that he would provide materials and labor for any equipment that we needed if we would provide the working plans. You are right!! I lost no time in providing plans and drawings.

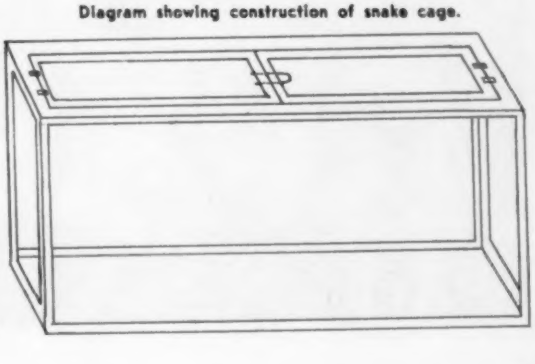
The foreman of our janitor crew supervised the work, which was done by N. Y. A. boys. He told me that the materials for the snake box cost about seventy-five cents and the materials for the large animal cage cost less than one dollar and a half. I was certainly pleased and surprised.

The large animal cage stands about four feet from the floor. The cage is two feet high, two feet wide, and three feet long. It is covered with one-fourth inch mesh hardware cloth on all sides except one. That side is glass, because it provides clearer observation and safety for inquisitive fingers. There is a large door at one end to make washing the inside of the cage an easier job. At the opposite end is a door the width of the cage, but only six inches high and hinged at the bottom. The combination food tray and water tray is just below this door. It is removable, so the animals need not be disturbed. It also has little hooks similar to the ones used to hang screens and storm windows, and never upsets or spills.

THE ANIMALS always have a dry bed because the bottom of the cage is covered with hardware cloth. The animal droppings go through the hardware cloth into a sliding

(Continued on Page Thirty-five)

Diagram showing construction of snake cage.



Science Clubs at Work

EDITED BY KARL F. OERLEIN

State Teachers College California, Pennsylvania

A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Oerlein.

Pennsylvania Junior Academy of Science

MARIE KNAUZ

Peabody High School Peabody, Pennsylvania

IT WAS a fortunate move when in 1934 at Reading, Pennsylvania, was organized the Pennsylvania Junior Academy of Science with fourteen science clubs for virtually all parts of the state. Placing a premium on state-wide pupil scientific achievement, it launched something never before attempted in the state and aimed to attract to science the same interest among high school students as had been drawn to art, history, etc.

To many high school club sponsors this meant students delving into hitherto untapped resources with various results, but with immeasurable gains in experience, self-improvement, and fun.

The nine annual meetings, held during the Easter vacation period at the same time and place as that of the Senior Academy of Science (four in the eastern, two in the central and three in the western part of the state) indicate the success of the idea launched by the American Association for the Advancement of Science in that year 1934.

Regional meetings have been initiated in the eastern, central, and western parts of the state when transportation to the annual meeting places presented too great a problem. Western Pennsylvania has had four regional meetings in Crafton High, Peabody High, Indiana, and Scottdale High Schools respectively.

EVER aware of the intrinsic values of the Junior Academy, Dr. Oerlein, as Senior Academy representative to the Junior Academy, has remained with it from the beginning. And the club sponsors still carry on!

The accomplishments of the fifteen through eighteen year olds read like those of an adult group when one pages through any annual program. Take that of March, 1942, presented at Edinboro, Pennsylvania, for

(Continued on Page Forty-four)

Peabody Science Club members at work.

Microscopic Identification of Woods

MATHIS BLACKSTOCK*

Austin High School **Student** **Austin, Texas**

THE purpose of this study is to identify species of trees and shrubs by microscopic examination of stem sections.

Two leaf specimens and one wood specimen from each of the more common trees and shrubs of central and north central Texas were collected. One set of leaves was kept for personal reference; the other was sent to the botany department at the University of Texas for identification. Twenty-two wood samples were sectioned and studied. Microscopic identification was then checked against the identification of the leaf specimen.

Sections of the samples were made with a hand microtome after the wood had been softened by soaking with water or steaming. Sections were stained with safranin. After staining, the sections were dehydrated in alcohol, cleared in xylol, and mounted with damar gum. Some of the sections were cleared and mounted in euparal instead of xylol and damar gum. Lantern slides and enlarged prints were made for the purpose of illustrating the project. Pictures were taken with a photo-micrograph camera, using principally the low-power lens of the microscope.

* A member of the Raymond L. Ditmars Scientific Society and Honorary Junior Member American Association for the Advancement of Science, 1942, representing Texas.

THREE different sections of a stem are cut. The transverse section is cut across the stem. The tangential is cut lengthwise through the stem anywhere except through the center of the stem. The first two sections are more commonly used.

The transverse section shows growth rings and cross sections of longitudinal tracheids and vessels. Figure 1 pictures a transverse section of red cedar showing a growth ring and tracheids.

The tangential section shows rays in cross section and a side view of tracheids and vessels. Figure 2 is a tangential section of red cedar. The groups of small cells are medullary rays. The long cells are tracheids.

The radial scetion shows a side view of tracheids and rays. The intersection of these two structures presents a plaid-like design, which is well illustrated in Figure 3, which shows red cedar and radial section. In these intersections are found small circular structures called pits. These pits connect one tracheid to another since no tracheid runs the full length of the stem.

Different species of wood are distinguished by the size, shape, and arrangement of their various structures. For example, the size of

(Continued on Page Twenty-six)

Fig. 1. Transverse section.

Fig. 2. Tangential section.

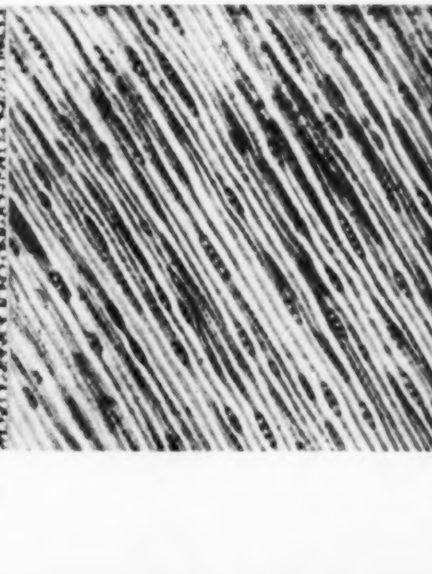


Fig. 3. Radial section.

Shooting Wild Flowers

PATSY TUCKER*

Austin High School **Austin, Texas**

MUCH HAS been said lately about the conservation of wild life. In this connection, Scientists conceived the idea of hunting for wild animals with a camera instead of a gun. The experiences in this paper deal with this type of hunting, and using, instead of wild animals, wild flowers.

My objectives were: 1. to develop interest in the beauty and variety of wild flowers and to help develop an appreciation of them. 2. To illustrate the correlation of photography as a hobby with wild flower study. 3. To promote the conservation of our natural beauty sources.

FOR MY hunting, I used an Argus C-3 camera and a Weston light meter. Kodachrome film was used which necessitated not a little difficulty in lighting as a prerequisite, since the use of this type of film needs to be in direct sunlight. The "F" stops, or course, vary with the amount of light, but I found the average stop to be about 4.5. The proximity of the camera depended upon the size of the specimen photographed. Since I used no special attachments in my photography, none of my pictures were taken at less than three feet. Most of them were photographed from three to six feet. The shutter speed of the camera depends upon the wind velocity. With most of my shots, I used 1/50 of a second. However, if the wind was strong enough to keep the flower moving constantly, I used 1/100 of a second.

The natural beauty of color pictures of flowers can be much enhanced by taking advantage of colorful back grounds. Probably the best example of this is the use of sky in pictures whenever posible; or at least finding a background as different from the specimen and lighter in color, if possible.

SINCE a knowledge of the classification of the flower was necessary to a better classification of them, I collected specimens whenever necessary so that classification could be made later. In classifying the plants, I used Shultz "Texas Wild Flowers" and Small's "Wild Flowers of the Southwest."

Even though my interest in this subject was great enough to start my work along these lines, I feel that my appreciation and knowledge has been greatly broadened after making the color slides and classifying the plants. I also hope that I may have made some contribution in this respect to others, as I have shown my slides to various advisory and club groups in our high school. Some discussion of conservation is also made at each showing to these groups.

Not only have I felt some success in attaining my objectives in these respects, but I feel that I have started on a very interesting hobby. For example, a number of the pictures were taken during a vacation trip in Colorado and New Mexico. It is surprising how much more one can enjoy a vacation if he can carry his hobby along.

For this project I have prepared 42 color slides of our native wild flowers. These include flowers from Texas, New Mexico, and Colorado. They are grouped according to blooming season.

* A high school student and a member of the Y. T. S. Botanical Society. This paper was presented before the Texas Junior Academy of Science.

IDENTIFICATION OF WOOD

(Continued from Page Twenty-three)

conducting vessels. In some woods these vessels vary in size according to the growth ring, the largest ones being in the spring portion of the ring. This type of wood is *ring porous*. In other species the vessels are the same size throughout the stem. These are called *diffuse porous*.

ANOTHER distinguishing characteristic is the size of rays in different woods, which varies from one to approximately thirty cells in area.

Some trees have no conducting vessels at all. This type of wood is called *non-porous*. All Gymnosperms are *non-porous*, and all Angiosperm woods have vessels and are termed porous.

War Service for Youth and Science*

WATSON DAVIS

Director of Science Service **Washington, D. C.**

THIS is a time when all the energies and intelligence of our nation must be devoted to rescuing the world from the ruthless forces of aggression. We must win the war. We must build a peace that makes safe the kind of world that will allow all people to live a constructive, satisfactory existence.

Our first task is to put an end to the war by defeating our enemies. Concurrently we may plan for the post-war period but if we let that interfere in any way with winning the war we shall find that others have made and enforced the plans which will not be to our liking, to say the least. Those who are scientifically inclined or trained, whether they be youth or adult, amateur or professional, have a special task in the war effort. This is a war in which science and technology hold trump cards.

The thousands of high school boys and girls who are members of science clubs and who show special aptitudes for science and technical matters, must lend their major energies to the war effort. Their teachers in doing their daily work in the classroom and as science club sponsors must orient their energies toward making this primarily a war service.

THE first concern of the boy or girl in these critical days should be to get the most out of his opportunity for science education both in the school and in the club. Just as a pilot must be trained before he can engage in combat flying, so the youth who aspires to become a scientific worker must gain knowledge and experience. Under the present incentive for student and teacher to intensify this training, accomplish it in the least possible time and make it as thorough and useful as possible. Both students and teachers should realize that training for science is just as important in its way as training for actual military service. The military research work that scientists are doing is recognized in this war to be as important as front-line military service.

Specially gifted science students should therefore be encouraged to continue as aggressively as possible their studies, in school and out, in order that they may join as soon as possible the ranks of those engaged directly in scientific research, for war so long as we need to fight, for peace when that happy time comes. It will not be unexpected if specially qualified students are enabled to speed up their studies as a war measure, doing say four years' work in three. Teachers have a great responsibility in facilitating such efforts.

The extra-curricular activities of science clubs are especially important in this intensification and broadening of science education. Progress can be made and experience ganied in club work that can not be achieved in formal class work. Under war conditions science clubs are justified in foregoing some of their usual projects to do tasks related to our military and civilian protection. In many cases the members will get more out of such work under the circumstances than they would out of the ordinary peace-time activities.

ONE OF the great services today will undoubtedly be cooperation with civilian defense agencies in the locality of the club. There are many specialized tasks that club members can be ready to do in case of emergency. Some of these, typically, would be water testing in the city water and health departments, aiding in the work of laboratory technicians in hospitals, operation of radio and other communication systems, acting as chemists in connection with decontamination squads, cooperation in telling the public how to fight fires and handle incendary bombs, helping in nutrition programs, assisting in first aid, etc. In some cases clubs and groups

(Continued on Page Forty)

* An extract from an address before the American Science Teachers Association, Dallas Texas, December 1942.

An Integrated Ninth Year

MORRIS MEISTER*

High School of Science **New York, New York**

WE write about this work with some reluctance. So much remains to be done; the problems unsolved are so much more numerus than the achievements. Yet the need to tell others must be met, if only for the purpose of clarification and the help which comes from the reactions of colleagues. More than anything else, the writer offers these prefatory remarks as a testimonial to twelve teachers who have shown rare devotion to a professional task—a task that has taxed their strength and drained their energies for a long while.

Background of the Experiment

AT one time, more than three years ago, the faculty of the school was composed of six chairmen of departments and a principal. With the vigor and enthusiasm characteristic of all beginnings, each of the chairmen resolved to fashion something good and of lasting educational value. Mistakes of the past were to be avoided. Here, at last, was an opportunity to build solidly and well. The problem of a philosophy acceptable to all did not prove too difficult, nor did the numerous hurdles incidental to building a school: the staff, the equipment and the organization. The first almost insuperable obstacle of consequence was the program of studies. Each chairman saw the philosophy of the school and its objectives in terms of his own subject. Excellently trained in one area of human culture, he laid vigorous claim to a place in the curricular sun. The fact is that no reasonable person could deny the claim. The special purpose of the school justified a science sequence and a mathematics sequence; the English sequence was secure because of tradition; the plea for social studies was both eloquent and convincing; foreign language pointed with assured calmness to "requirements", as did the champions of health education; the advocates of the fine arts spoke of enrichment and of leisure and of the "finer things of life."

A TABULATION was finally achieved which gave each of the major subjects a three or a four-year horizontal line from the ninth year to the twelfth. The nub of the problem, however, arose in a consideration of the vertical columns. These indicated a pupil's activity in any one year. The pupil moved from one compartment to another. As the change-of-period bell rang, the door closed upon one isolated experience and another door opened to a new one, five or six times a day. There was no assurance that one teacher knew or cared about what the other was doing. If inter-relationships developed, they were entirely fortuitous. If duplications existed, they were discovered by chance. Yet we know that the pupil lives one life; his growth and development proceeds as a *whole*; his efficiency as an individual and as a citizen is in direct proportion to the degree to which he can perceive *relationships*.

Departmental Orientation

Recognizing this obvious deficiency in a curriculum composed of well-developed "horizontal sequences," the chairmen undertook to educate each other in an appreciation of the other fellow's subject-matter contributions to to education of the child. This was done by a committee of representatives from all departments. Weekly meetings of long duration were held for an entire school year. In a Science school, the chairman of the committee was, by design, a foreign language specialist. Syllabuses were studied and analyzed. Teaching procedures were examined. Philosophies were expounded and criticized. Duplications were eliminated; relationships delineated. In effect, the experience was the finest kind of in-service course. After a year of work, the report and its conclusions struck a note of pessimism. While a group of professionally-minded special subject teachers could accept each other philosophically and find common

* **President of the American Science Teachers Association and Principal of the High School of Science of New York City. This article reprinted by permission from *High Points*, April, 1942.**

ground here and there, they saw no immediate way of translating theory into classroom practice.

A Single Class

However, careful consideration of the report did lead to a suggestion. Why not take a single class of ninth graders and turn them over to a team of five teachers? Let us see what happens when these teachers are freed to plan together *all* the work of this class. After a year of discussion, the teachers had absorbed a point of view and an understanding of the nature of the problem. They were fired with a desire to try. Only two requirements were imposed upon their efforts: they must plan the course together and they must do only what all agree is educationally desirable. Any and all syllabus prescriptions should be discarded; many degrees of administrative and supervisory freedom were permitted; programming arrangements were such as to make out-of-school excursions possible. No teaching or administrative allowance was given to the teachers. They found time, nevertheless, for numerous conferences in "free" time, after school, evenings and week-ends. To confer became a vital necessity.

THE work with one class proceeded for an entire school year. Slowly units of study evolved, to which all subjects contributed, not always in equal amount. More and more frequently, the science teacher found himself teaching social studies and the English teacher, science. Increasingly, the pupils began to lose track of "subjects" and to become involved in the solution of "life" problems. Art and music and mathematics entered into the experience, each serving an important need at definite and natural stages of the work. At the end of the year, these were the gains, subjectively evaluated:

1. The teachers liked the experience.
2. So did the pupils.
3. The teachers learned how to work with each other, to plan together and to "talk each other's language."
4. A number of ingenious and effective teaching procedues were developed; such as conference techniques, organization of trips, workshop methods in the classroom, and the "integrated examination."
5. There was evidence of social cooperation among the pupils and of individual responsibility for group achievement and dsicipline.
6. A group of tentative Units of Study was developed.

AT the close of the year, the class was absorbed into the traditional tenth year of the school. The fact that the pupils have been able to carry on and to profit by the school's curriculum without any discernible difference as compared with others, would indicate that their ninth year experience has not been a disadvantage. There is some opinion, in fact, that these boys are doing better in some ways than those who did not have the "integrated work."

When the first class was disbanded, another ninth year class was formed. This time, a so-called "control" group was also established. The same group of teachers continued the work. Dr. Irving Lorge of Teachers College was then called on to help us with the evaluation.

Results

THE results were such as to give encouragement to a further extension of the integrated approach. In September 1941, therefore, the entire class of entering ninth graders were inducted into the reconstructed curriculum. The necessary teachers were added and another evaluation was planned. Some of the details of the units and of the procedures employed are presented and discussed in the article by Dr. Isabel Gordon, teacher of English at the High School of Science. Dr. Gordon acted as chairman of the group, which included: Mr. Theodore Benjamin, teacher of Science; Mr. Julius Hlavaty, teacher of Mathematics; Mr. Alexander Breinan, teacher of Social Studies; Mr. Toby Kurzband, teacher of Art; Dr. Alexander Joseph, teacher of Laboratory Science; Miss Rachel Povereny, teacher of English; Mrs. Ruth K. Schoenberg, teacher of Social Studies; Miss Martha Martin, teacher of

Mathematics; Mr. Edward Lepowsky, teacher of Mathematics; Mr. Hyman Rensin, teacher of Music; Mr. Nathan Levy, teacher of Science.

As Dr. Lorge indicates in his study, "No mere statistical evaluation of differences between . . . groups can fully reveal all of the gains made. . . . " While the differences are in no sense dramatic, they are assuring in many ways. When added to the subjective evaluation by pupils, by teachers and by supervisors, the net gains are decidedly encouraging. The teachers are unanimous in their belief that they have been able to give pupils a more meaningful educational experience. Despite the hard tasks and long hours involved, practically everyone has volunteered to continue in the work.

Programming

IN a school of 2000 pupils and in a building of limited capacity, it is sometimes impossible to arrange the program so as to provide for all the special needs of integrated study. Frequently, it is done at the expense of optimum arrangements for the rest of the school. This tends to breed dissatisfaction. The problem is aggravated by the fact that some of our subjects are given four periods a week, others five periods, still others six periods, some seven periods and a few ten periods. In the case of laboratory work, shop work and mechanical drawing, double periods must be scheduled. All this creates a jig-saw of huge proportions and extreme difficulty. In a large school, with fewer irregularities in time allotments to subjects, the difficulties would be less severe.

Time for Teacher Conferences

A *SINE qua non* for teaching by the integrated approach is time for teacher conferences. Cooperative planning can be achieved in no other way. Continued experience with collaborative and consultative processes will make conferences more fruitful and expeditious; they will not eliiminate the need for them. Inherent in this kind of teaching is a constant consideration by several teachers together, of the needs of specific children and the best means of furthering their growth.

Hence, the time schedule must provide for teacher conference periods. This can be done in a number of ways. Once a week, several classes are scheduled so that they meet in large groups; this releases most of the teachers for conference. The "audience' activities engaged in by the large groups and the educational goals achieved are described in Dr. Gordon's paper. Another device is to employ building asignment time for conference periods. Still another means for furnishing conference time, where a major portion of a teacher's teaching load is confined to the integrated curriculum, is to draw upon the time devoted to departmental conferences and extra-curricular arcivities.

During the early stages of our work, the sources of conference time indicated above were inadequate to meet the needs. Much additional time was contributed by the teachers participating. It is the contention of most of them, however ,that continued planning and growing expertness will reduce the time factor considerably. Many of us are convinced that adequate conference time can be made available within the framework of the plan, without increasing the cost of instruction.

Building Facilities

THE type of teaching involved in the integrated approach makes necessary a number of facilities lacking in many schools. Among the more important items are adequate libraries, movable furniture, workshops, laboratories, and at least one room in addition to the auditorium that can accommodate three or more classes for audience presentations. The lack of some of these facilities has handicapped us greatly. During the past three years, our building has been revamped by a W.P.A. project. One of the remarkable achievements of the group carrying on the integrated work, was their ingenuity and patience in adapting themselves to rooms torn apart by plumbers, electricians and plasterers and a veritable army of workmen always present while they carried on with the educational tasks in hand.

(Continued on Page Forty-five)

Manufacture of Water Gas with an Electric Arc

ALEXANDER PADOW

Boys High School — Brooklyn, New York

THE apparatus is set up as shown in the diagram Figure 1 with the delivery tube leading to a six ounce bottle filled with water and inverted into a pan of water. The water in the flask is boiled until all the air has been expelled. This is indicated when the gas issuing from the delivery tube no longer displaces water from the six ounce collecting bottle. The delivery tube is then transferred to a larger collecting bottle similarly inverted into a pan of water and the carbon electrodes are sparked. The action is continued until all the water has been displaced by water gas. The bottle of water gas is set upright as shown in diagram 1a and water is allowed to fill it. With the gas issuing from both tubes, the tubes are lit. The luminosity of the enriched gas is noted.

The proper amperage is determined beforehand by setting up the apparatus with an alternating current ammeter and variable resistance in series with the apparatus circuit when the carbons are sparked. The resistance is adjusted so that 3 to 4 amperes of current are consumed. The ammeter may then be removed from the circuit and the apparatus is prepared for demonstration.

Figure 1 is a diagrammatic representation of the steam flask and reaction chamber. Figure 2 is a detail of the movable carbon electrode.

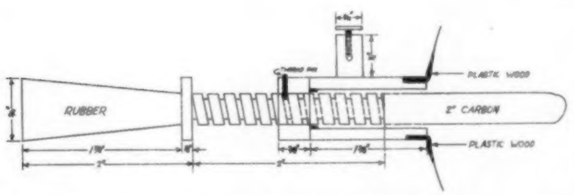


Fig. 2. Movable carbon electrode (detail).

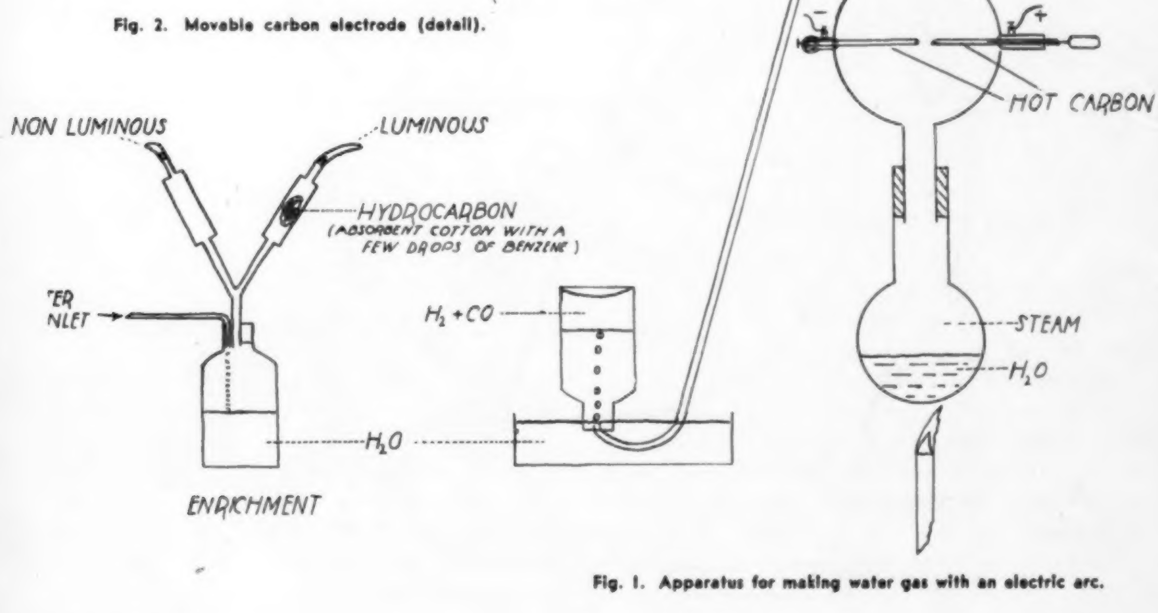


Fig. 1. Apparatus for making water gas with an electric arc.

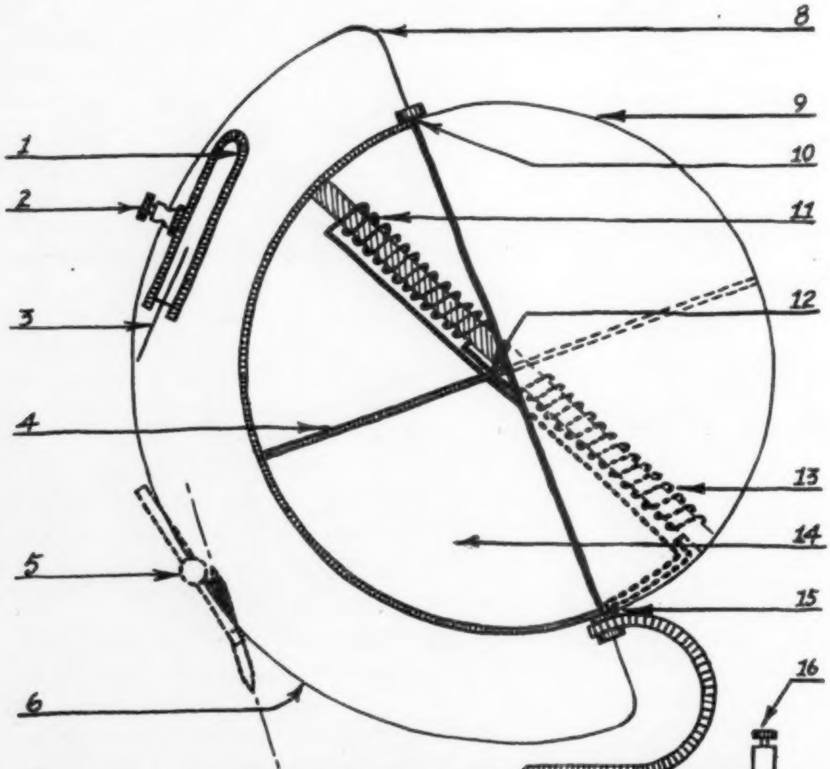
Terrella and Corona Effect Apparatus

HARRY MILGRAM

Evander Childs High School — Bronx, New York City

A LARGE SCALE electromagnetic earth model (terrella) for demonstrating the significance of the angles of declination and dip and their values at various points on the earth, may be simply constructed as follows: (The specifications are for a globe having an eight inch diameter.) Use a hack saw to cut halfway around two longitudional circles of the globe (9) which make a ninety degree angle. Use the circles near the Hudson Bay region, but do not include the region between them. Remove this quarter section (14) and cement a metal strip to it, so that it may be put back into position. One or two slots are cut into the cardboard reenforcement (4) to receive the metal strip. Wind two electromagnets on iron cores (11 and 13) that can be wedged into place between the interior of the globe and the axis. Soft iron 3½ inches in length and ¼ inch in diameter is suitable. Wind four layers of #22 insulated copper wire, with 75 turns to a layer, on each core. Place the electromagnets into the globe with turns going in the same direction. Connect the coils in series through holes drilled at 12 and bring the connection wires through 15 to two binding posts at 16. Mark the binding posts plus and minus so that 11 is a south pole when the current flows through the electromagnets.

Solder a binding post (2) to the support (1) of an ordinary four inch dipping needle (3). Bend a 24 inch length of #10 gauge bare copper wire into a semi-circle of six inch radius (88). Place the binding post (2) on the copper semi-circle (8) and attach the



Electro-Magnetic Terrella

wire to the north and south geographic poles. Mount the globe with its axis properly inclined on a wide wooden base (7).

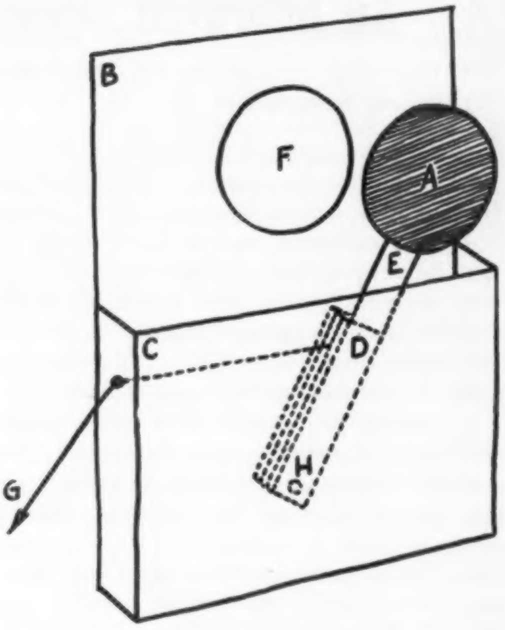
TO OPERATE the device, attach four dry cells connected in series to the binding posts (6). Place the needle in position (2). The north pole of the needle swings toward the magnetic pole. The angle between the needle and the copper wire support (which gives the north-south direction) is the angle of declination for the portion of the earth directly under the needle's pivot. The direction of deviation (east or west of true north) is also evident. Place the needle in position (5). The needle assumes a position parallel to the direction of the lines of force at that point.. The angle (6) between the needle and the copper wire support (which represents the horizontal at any given point) is the angle of dip for that region.

Practically every region of the globe may be explored in this manner, by turning the globe (9) and by shifting the position of the binding post (2) on the support. Current strength may be increased or decreased to regulate situations where the needle is too weakly or strongly influenced.

CORONA EFFECT

Polar eclipse models usually show the paths of light rays but seldom attempt to duplicate the actual appearance of the sun throughout the eclipse. The model under discussion shows the moon cutting into the face of the sun, the corona effect at totality and the moon leaving the face of the sun.

The model can be constructed in the following way: Cut a three inch hole (F) in the heavy cardboard B. Cement to the back of B, to cover the opening a material which permits a diffused orange light to pass through. Synthetic orange amber or several alternate layers of orange cellophane and tissue paper may be used. Cement several strips of cardboard together to form support D. Attach a piece of celluloid E to D to form a rigid, invisible arm for A. Cut circle A slightly smaller than F and attach to E. A is black on the side seen in the diagram and white on the other side. D is atached to cardboard B by means of a brass paper fastener at H. The shield C is cemented to B to cover part



Corona Effect.

of D of the moveable arm. A string attached to D and running through a hole in C motivated the device.

TO operate the corona model, place a flashlight behind the orange disc F. Darken the room. Set disc A in the position shown and slowly move it across the orange disc by pulling the string G. Because of the invisible support, the "moon' appears to float across the face of the "sun."

When A is directly opposite F, the white surface of A reflects the orange light in an irregular streaming manner, to produce a spectacular corona effect.

ACTIVITY OF HALOGENS

(Continued from Page Sixteen)

weight of 35.5. Bromine, atomic weight of 80. Iodine, atomic weight of 127.

THE equipment used in this demonstration is large enough to be seen in all parts of the classroom. Because all three halogens are prepared at the same time the demonstration serves to illustrate their relationship by comparison and the relative replacement power of this family of elements.

An Improved Demonstration Transformer

ISIDOR AUERBACH

Lafayette High School **Brooklyn, New York**

THE essential features necessarily present in good lecture demonstration equipment are few but vital. Among these are the following:

1. The apparatus must be large enough so that its features may be clearly seen. Not only must the entire piece be visible to the students in the back rows, but the individual important sections must be on a large enough scale so that they, as well, are visible.

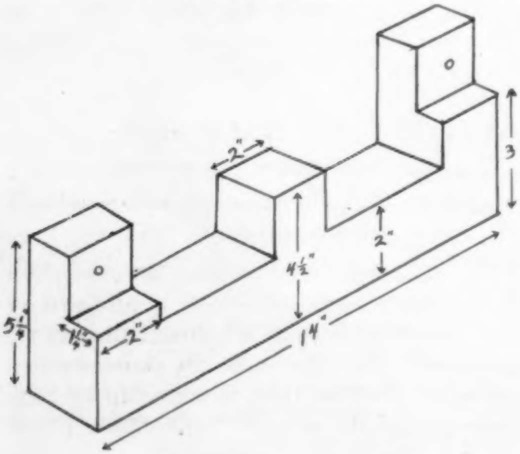
2. To conform with the above requirement, simplicity of structure must be stressed. The essential features alone must be present, so that the principle to be illustrated will be easily grasped.

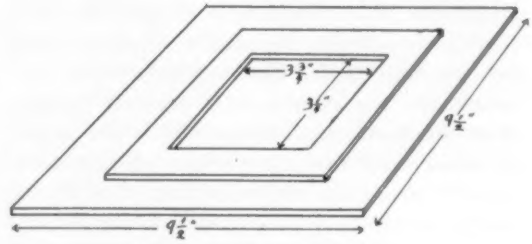
3. The apparatus must be capable of being torn down and reassembled easily and quickly. Provision for changes suggested by students is desirable.

4. The apparatus should produce results of the order of magnitude of like apparatus in the student environment.

Let us apply these crieteria to the ordinary demonstration transformer used in physics classes. In the first place, it is too small. The primary and secondary coils are so wound that it is very hard for the student to see them. A profusion of binding posts confuses the beginner. There is usually no way to disassemble the transformer quickly and easily. The output voltages are not such as to impress the student with any sense of practical value.

E piece of transformer.





Secondary pie of transformer.

WITH these criteria in mind, as here listed, a transformer was designed and built. The complete core is 14" x 10" and has proven large enough for classroom use. The core is the E shaped type and is composed of two similar pieces. They are bolted together. The center leg has an area of 5 square inches, which is sufficiently large for the power capabilities. The two E shaped pieces are cast of grey castiron and have a total weight of 45 pounds. The primary and secondary coils are distinct from each other. The primary consists of 150 turns of #18 D.C.C. wire wound upon a cardboard form so that it slips easily on the center leg of the core. The turns are in three layers separated by layers of paper and the entire coil taped.

FIVE secondary pies were wound. Each consists of 1250 turns of #36 D.C.C. wire wound upon a square form 4¼" x 3¾" and with sides ¾" apart. The resulting coils are ¾" thick and have an outside size of approximately 8" x 8" depending upon the tightness of winding. This is thoroughly taped and substantial leads brought out. Each coil is glued to a flat piece of prestwood or plywood 9½" x 9½" and with 4¼" x 3¾" hole cut in its center. This board should be painted red. Two fahnestock binding posts are connected to the leads.

(Continued on Page Forty-two)

ANIMAL CAGES

(Continued from Page Twenty-three)

metal tray below, which covers the bottom of the cage. The tray is about one and one-half inches deep and is always lined with newspapers. The cages are painted inside with white enamel.

Two children, chosen for care and dependability, are assigned the job of cleaning the animal cage. They also provide the day's rations of food and water for the animals. These have been about every kind in the area, including chickens, a pet lamb, and a six foot bull snake. There is usually a waiting list of children who want to bring some pet or animal.

Two more children are asigned to the snake cage. Once each week, the cages are washed and scrubbed with hot soapsuds. The pan for bathing, the drinking jar, and the pile of rocks which aid in skin-shedding must be scrubbed in hot soapsuds, too. The children learn valuable lessons in responsibility. Since I must proceed with the day's lesson, those children are held responsible for a good clean job. They, too, participate in the class discussions as they work. If they do not do the job well, other children are given a try-out.

THE SNAKE CAGE is placed upon a table which brings the snakes on an eye-level with the children. I have watched many children overcome their fear of snakes by watching them at a safe distance. The animal cage is easily observed at all times from any part of the room.

Identification and information is in evidence on the cage at all times, plus the name of the contributor. My live animal observation problems now total almost zero. Once in a while a new-comer tries teasing. When this happens, he gets told in no uncertain terms by one of the children. Often I have heard, "Can't you read? Don't you see that label says not to tease? Anyway, they are really our friends."

I have enjoyed sharing my plans and experiences with you, and I am certain that there are others that have much better ideas or plans. Please, won't you let us hear yours?

INSECT FRIENDS

(Continued from Page Twenty-one)

had fed within the tissues of the caterpillar and when full grown had cut their way through the body wall, and spun their cocoons fast to the host. Very soon a small black wasp will cut its way out of each cocoon and the females will soon be looking for more caterpillars.

MANY insect eggs are destroyed by very small parasites which develop in them. Figure 8 shows one of these wasps which confine themselves entirely to insect eggs. This parasite is known to attack the eggs of more than 150 different kinds of insects.

The female wasp wanders about over the foliage searching for eggs which she may attack. When these are found, she climbs upon each in turn, and deposits an egg through the shell by means of a sharp egg-laying struc-

THe entire development from egg to adult wasp may be completed in one week. Thus one can see that an exceedingly rapid increase is possible. This tiny wasp undergoes its full development inside the attacked insect egg just as the first one mentioned developed inside the parasitized aphid.

In this discussion we have given brief accounts of some of the more common parasites and predators. This should help a person to realize that not all insects are harmful. Should more information be desired, the following bibliography will be found helpful.

Bibliography

(1) Clausen, Curtis P. 1935. *Insect Parasites and Predators of Insect Pests.* U. S. D. A. Circ. 346, illus.

(2) Metcalf, C. L. 1916. *Syrphidae of Maine.* Maine Agr. Exp. Sta., Bul. 253, illus.

(3) Metcalf, C. L. and Flint, W. P. 1939. *Destructive and Useful Insects.* Pages 54-64. McGraw-Hill Book Co., New York.

(4) Smith, R. C. 1922. *The Biology of the Chrysopidae.* Cornell Ar. Exp. Sta., Memoir 58: 1287-1372, illus.

(5) Wildermuth, V. L. 1916. *California Green Lacewing Fly.* Jour. of Agr. Res. VI (14): 515-525 illus.

METALS IN WAR

(Continued from Page Fifteen)

much faster. In time of war this is a vitally important factor when the demand for more and more equipment is such an important part of the program. The nation which has an adequate supply of tungsten, therefore, has a decided advantage in a struggle in which machines play so vital a part.

MOLYBDENUM is closely related to tungsten and in the steel industry these two metals are used for much the same purpose. The United States is the principle producer of molybdenum, as is shown by the fact that in 1939, the last year of published records, this country produced 92% of the World's supply. By a curious chain of events the use of molybdenum steel has developed more rapidly in Europe than it has in this country, while our steel makers have been more interested in tungsten steel. Some American authorities have regarded molybdenum as a substitute for tungsten or even as an adulterant. In recent years, however, molybdenum steels have gained the confidence of technical men and now it is prized on its own merits. As a result the use of molybdenum steel has increasd steadily especially in the oil, automobile and aircraft industries. Since the deposits at Climax, Colorado are said to be capable of producing ore at the rate of 1000 tons per day for 30 years there is no immediate cause for anxiety concerning the supply of molybdenum unless there should come a sudden and unexpected demand for a greatly increased amount of this interesting metal.

ANOTHER of the less familiar metals, vanadium, is inseparably connected with the steel industry especially in this country. The leading producer of vanadium is Peru, with the United States running a close second. The states of Arizona, Colorado and Utah supply about 48% of our domestic needs, which in normal times amounts to a little over 2000 tons of the metal per year. The principal use of the metal is in the production of alloy steels, particularly in conjunction with other alloying elements. Only small quantities of vanadium are necessary for the production of some remarkable results. Dr. Jerome Alexander, a leading authority on vanadium, makes this statement: The average motor car would have only about 4 ounces of vanadium in it, and the average airplane engine only about 1 ounce, but the benefits secured from such small quantities are almost incredible." Compounds of vanadium are used in the manufacture of sulfuric acid, glass, pigments and in a great many other industries. We are fortunate in having an adequate supply of vanadium.

Beryllium is a metal which has attracted no little attention because it is commonly referred to as the lightest of our rigid metals. Many elaborate claims have been made with regard to the use of this much misunderstood metal. It has been said for example that the German airplanes are protected by a very light and very tough armor plate of beryllium. Such statements are evidently not authoratative for the cost would be prohibitive even in a time of tremendous expenditures. The metal sells for about $50 a pound. However its copper alloys are very interesting and it is likely that they may assume considerable importance although their present value in war production is not great.

NO discussion of our mineral resources in time of war would be complete without a brief reference to potassium, whose compounds are indispensable in maintaining soil fertility. Previous to 1914 our supply had come from European sources, and when that supply was suddenly cut off there was the gravest anxiety for fear of a shortage in food production. Prices rose about 1000 per cent and frantic efforts were made to recover potash from the dust of cement mills, and blast furnaces, from wood ashes, from molasses residues, from the giant kelp of our western coast and from various deposits and potash-bearing rocks. When the armistice was signed, it is very fortunate that the United States government did not relax its efforts to make this country independent of European potash. In the years that have intervened since 1918 our potash industry has grown steadily and it has been established that our production in 1941-42 would be about 509,000 tons of

K_2O, which is practically equivalent to the normal demand of the entire western hemisphere. So we not only have no present fear of another potash famine, but for the first time in history our supply is abundant enough to take care of our own needs and at the same time divide with our less fortunate neighbors.

A STUDY of the mineral resources in the present emergency leads to three important conclusions: (1) Economy in the use of all metals is necessary; every individual should be keenly alert to the need for saving all metallic scrap. (3) Our natural resources with respect to strategic minerals whose supply is limited should be expanded in time of peace, in order that sudden emergencies like the present may not leave us handicapped for lack of necessary supplies. (3) In the case of those minerals whose American sources are not equal to our needs, adequate reserve stocks should be maintained at all times.

PRE-FLIGHT AERONAUTICS

(Continued from Page Seventeen)

Aeronautics Authority, on June 30th, less than four months after the first conference was called.

Throughout this work, this group of men were conscious of the thought that the boys now in the upper grades of the high school would be called upon to man the fighters and bombers. It was obvious that they would come from schools with the poorest factilities as well as from the schools with the finest equipment.

This realization made it evident that the texts must be of such a nature that teachers having inadequate equipment and those with no specialized training will have to be encouraged to undertake the important task of doing everything humanly possible for the boys now within the comparative leisure of the last two years of high school. Every effort was made, therefore, to make the texts simple and clear, to make them rich in illustration, to provide the answers to boys' questions, to provide for simple demonstrations that could be created by the boys themselves out of inexpensive or scrap materials. This accounts for the total of some 900 pages[2] to cover the ground dealt with in 300 pages in the Civilian Pilot Training Manual. This accounts for the inclusion of demonstrations in the tests themselves, where students can have access to them. It accounts for the 250 page teachers manual[3] geared closely to the text.

FOR the sake of these tens of thousands of boys in city and country who are destined to be "the few to whom so many will owe so much," it is hoped that thousands of teachers, armed with a willingness to work these matters out with the boys themselves, will dare to undertake this inspired task. They must not, they dare not, approach this problem in the accustomed manner. They must do all they can to build understandings and skills into the nervous systems of these boys, so that whatever subsequent training they may get in the military service will be that much more assurance of brilliant service on the field of battle and of triumphant return when the battle has been won.

What has been done has been done in a crusading spirit — the men from these schools, Robert Hinckey and his staff of the Civil Aeronautic Authority, and the pioneering spirits in the ATCA organization, are a group to which this fall has been added tens of thousands of teachers in the schools of America — public, private and parochial — and many leaders of boys groups where the schools themselves fail to rise to the challenge.

Having said this, it should also be said that, although those of us who worked on this project found the needs of these boys in war stimulating enough, the science of aeronautics phase of the program has a broader setting than war. These students are not only to be called on to fight the battles of this war; they will be prepared to be pioneers in a new age of air, when this war finally has been won.

[2] Aviation Education Research Group Project, Teachers College, Columbia University, Science of Pre-Flight Aeronautics for High Schools, Macmillan, 1942.

[3] Aviation Education Research Group, Teachers College, Columbia University, *Teachers' Manual for Science for Pre-Flight Aeronautics for High Schools*, George Franklin Stover Editor, Macmillan, 1942.

NEW SCIENCE FOR YOUTH

(Continued from Page Nine)

seriously hampered, when we choose one course of action expecting a certain result and find that something entirely unexpected happens. The application of the scientific method, and its attendant attitudes, to the choice of a course of action is probably the best way yet developed to increase the probability of an accurate prediction of the outcome of that course of action. The materials of science are well adapted to the development of competency in the use of this method. It must become a part of the content of all science courses. Courses must be organized so that students are helped in identifying problems in situations, formulating hypotheses, planning solutions, drawing sound conclusions, and acting in accordance with the conclusions reached. They must also learn to practice the scientific attitudes. It means placing as much, if not more emphasis upon methods of procedure as upon facts and principles to be learned. No longer can the science teacher say, "I don't care how you do this as long as you get it done!" How a student works is of prime importance. What he does is of equal importance. Remember the early assumption that the amount of positive transfer is partially dependent upon the individuals making a conscious effort to use a technic he thoroughly understands. If this assumption is accepted, and there seems to be some evidence in support of it, there is no alternative with respect to method. It must become an important part of the science you and I teach.

MANY other characteristics of a science based upon the accepted assumptions could be outlined. However, I for one, would be extremely pleased if just these two things happened to our science courses. First, let's have a science that is concerned, actively, with the solution of common social problems. Second, let's make our science teaching an irresistible example of the use of the scientific method and attitudes in helping us choose wise courses of action. When these two things have "come unto" the classrooms of the

country, you and I will have gone a long way toward providing youth with the kind of science they must have to live most successfully.

VICTORY CORPS

(Continued from Page Ten)

In addition to the regular class instruction some schools are organizing refresher courses taught during some hour that is open to all interested boys, such as a home room hour. Such a course is broken up into units, as for example, 8 weeks of mathematics, 2 weeks of meteorology, 2 weeks of first aid, 6 weeks of chemistry, and 18 weeks of physics, including electricity, communications, and pre-flight training. Each unit can be taught by a different teacher, thus distributing the load.

As to helpful material, there is a wealth of it available. In addition to the Victory Corps material specially prepared for the schools, there are many special texts being published that are suited to the need. Also there are manuals used for army instruction that can be had at low cost for class use by writing to the Superintendent of Documents, Washington, D. C. The following list has been supplied us by Captain Ray C. Soliday of the Chemical Warfare Service, Chicago area.

War Department Publications of Interest

TECHNICAL MANUALS

TM 3-215	Military Chemistry and Chemical Agents	.25
TM 1-455	Electrical Fundamentals	.25
TM 9-2900	Military Explosives	
TM 10-225	Inspection of Textiles	.15
TM 5-235	Surveying	.70
TM 8-227	Methods for Laboratory Technicians	
TM 1-320	Airship Aerodynamics	.15
TM 3-240	Meteorology	
TM 1-400	Theory of Flight	.30
TM 1-325	Aerostatics	.25
TM 1-315	Hydrogen	.10
TM 1-406	Aircraft Electrical Systems..	

FIELD MANUALS

FM 21-10	Military Sanitation and First Aid	.25
FM 1-45	Signal Communication	
FM 1-30	Air Navigation	.15

(For the above material write the Superintendent of Documents, Washington, D. C.)

WAR SERVICE FOR YOUTH

(Continued from Page Twenty-five)

within them can undertake research problems that arise in connection with civilian defense, such as tests of blackout materials and methods, etc. Clubs and members particularly interested in psychological and statistical problems can find opportunities in connection with civilian defense activities.

There is a good chance that the participation of youthful scientists will be mobilized under a national scheme with the cooperation of Science Clubs of America, and with the action programs integrated with the local civilian defense effort. The following statement has been issued by the Office of Civilian Defense: "Total war demands the participation of each American citizen. Young people working side by side with adults can contribute energy and talent to the war effort." It is quite possible that in the accelerated production program of industry the more advanced science club members can give auxiliary service in laboratories or plants. Under the emergency conditions such efforts may be coordinated with scholastic programs.

WHILE this essential war work is undertaken, there will be a place in many instances for the usual peace-time activities on a restricted scale. From a morale standpoint alone some activities not related to the war will be justified. Some activities, particularly in the less applied fields of science, are necessary from a broad educational standpoint. Astronomy, nature study, animal breeding, and similar activities should be undertaken for their sakes alone and for the skills and training that they give the participants.

In this reorientation of the science club movement to national war-time service, Science Clubs of America, sponsored by Science Service, will lend its maximum effort. Some of the plans announced before the coming of war will be changed to allow greater war service. I am sure that every regional and local science club center will join wholeheartedly in the new and changing program

as it becomes necessary. The only objective of Science Service in participating in the science club movement is that of service to the nation, the clubs, the members and the other cooperating organizations.

IN picking up the national activities formerly conducted by the American Institute of the City of New York, in cooperating with the many state and city organizations, Science Service has pledged not only the maximum of its effort but it has reinforced the national science club movement with its many media of distribution — its services to newspapers, its radio programs, its weekly *Science News Letter*, its *Things* of science, etc.

The participation of newspapers served by Science Service in the movement is a very important development of immense potential support to local situations. The Science News Letter is a means of speedy communication to clubs and messages of importance will be distributed in that way. There are now about 30,000 science club members in some 800 clubs throughout the nation and beyond our borders. There should be at least 100,000 members in 5,000 clubs and the clubs should spread through the hemisphere and eventually the world.

IN the science clubs for youth the high school science teacher is a key person for he or she can inspire a group to begin and carry on in this activity. I believe that there is a very large opportunity for service in connection with the organization of adult science clubs in which amateurs of mature ages can get much pleasure and benefit out of science activities. This is a development in which science teachers can give added national service in these days of war. Professional scientists to an increasnig percentage are engaged in essential military research. It is now fitting and necessary that amateur scientists of all ages shall enlist in this great undertaking.

OUR OPPORTUNITY

(Continued from Page Twelve)

MORE work is also needed on the in-service training of teachers for elementary and junior high science. The thousands of elementary and junior high teachers now at work in our schools know very little about science or how to teach it effectively. Yet they are the teachers who are going to have to do the work, and procedures must be developed for training them easily and inexpensively.

More information is needed on effective procedures for guiding pupils to form desirable habits and attitudes as they attend school. Much of this is in the field of elementary science, since many of the habits and attitudes have to do with the pupil's reactions to his environment and to his body. The status of health education in our schools is deplorable at present, and elementary science can do much to improve it.

These and other pressing problems cannot be solved by college professors and administrators alone; much must come from the classroom teachers of America. We must encourage good teachers everywhere to strive to do better work and to report their successful techniques in this magazine so that they can be used by others.

THESE times call for hard work and realistic thinking on these and other problems in science teaching. With such work we not only promote the teaching of science, but we aid materially in making America's mass education endeavor a success. Remember that the future of our nation depends on our young people — not entirely on those who are going into the armed forces to win this war for us, but also on the next generation of youth who will take over and build on what we will be able to leave them.

Demonstration Transformer

(Continued from Page Thirty-five)

Completely disassembled, the class can be shown the core pieces, the primary, and the secondary pies. The primary is slipped over the center core piece and the secondary pie put in place and the two core pieces bolted.

WITH 110 V on the primary the secondary will light an ordinary small commercial neon light sign. Larger signs may be operated by slipping in more pies and connecting the secondaries in series. With all pies in place an output voltage of 5000 V is possible. Be careful in its use. At the same time the transformer may be connected in reverse and a small flashlight bulb lit. As a final demonstration, a coil of 8 turns of wire may be slipped over the primary and the transformer used to show step-up and step-down functions at once.

This apparatus may be modified as the pupils suggest new ideas. A new primary of greater turns may be easily built to show the turns per volt relationship. Hysteresis losses in the core are large enough to warm the center core piece. The idea of laminating the core can be discussed.

In actual classroom use this large transformer has definitely improved the pupils' conception of electomagnetic induction.

JUNIOR ACADEMY

(Continued from Page Twenty-four)

example, with subjects such as the following: "Klystron," "Aerodynamics," "A code Practice Oscillator," "Mounting Specimens in Plastic," "High Vacua." "X-Ray Photography."

A further incentive to student endeavor is the new plan inaugurated this year of awarding annual honorary memberships into the Senior Academy of Science to the boys and girls who are nominated as worthy by their club and sponsor. Besides these new awards the older award of one honorary Junior membership in the A. A. A. S. for a boy and a girl is still the highest honor. This year the science clubs of Taylor Allerdice and Scottdale High Schools carried off these honors.

FOR 1942-43 a student from Scottdale High School Science Club is president, one from Peabody High School Science Club is vice-president, and from Steinmetz Scientific Society, Upper Darby High School, is secretary of the Pennsylvania Junior Academy of Science. With the possibility of cancellation of the 1943 convention at Beaver College, Jenkintown, and good sponsors being called into the country's service, the Juniors are modifying their plans to suit a changing world. It is suggested that they hold an annual meeting in their own locality and thus have ideas exchanged between schools not too far removed from each other.

In 1940 the Pennsylvania Junior Academy of Science held its first annual Science Fair in collaboration with the American institute of Science and Engineering Clubs and the Buhl Planetarium, Pittsburgh. Last May the third Annual Science Fair was held. This time the Buhl Planetarium led the way. That the Fair is continuing under western Pennsylvania's far-famed science organization marks progress in the history of the Junior Academy. For junior members continue to participate and continue to depart with honors.

INTEGRATED NINTH YEAR

(Continued from Page Thirty)

Teacher-Education

THE problem of teacher education is of vital importance. The faculty as a whole must accept the worthwhileness of the project. In one way or another every teacher's burden is added to somewhat, in order that the new approach may be developed. Hence, faculty conferences and departmental conferences must be held and the aims of the work thoroughly explained and fully discussed. The time needed for this is not always available.

Promotions

WHAT shall be done with the pupil who does unsatisfactory work? No simple provision for failures seems possible where all the pupils in a given grade of a subject are taking the work of an integrated curriculum. The only solution to this problem is to organize homogenous groups of varying ability and to facilitate transfers from one group to another. This device, together with a policy of 100 per cent promotion at mid-year, may meet the situation in most instances.

Applicability of this Work to Other Schools

IT would be rash to predict the effectiveness of an integrated ninth year curriculum in another school, with different pupils and other teachers. This article is not written because a new teaching method has been discovered that is universal in its application. We record our experiences because they explore a kind of education that is growing in importance and which seems to yield value wherever it has been tried. We find little in our approach that is uniquely dependent upon dealing with bright pupils. Nor have our efforts been made easier by the fact that all of our ninth graders believe they are interested in science as a future life work. Such valuable outcomes as have been achieved and the difficulties that have arisen are not conditioned by the specialized nature of the school and its selected student body.

A WORK PROGRAM

(Continued from Page Thirteen)

content provided for high school pupils with the thought in mind that for many pupils such training is terminal

THE second proposal that I would like to make, which unfortunately will be made in the vaguest sort of way, is that the science teachers attempt to survey the needs of the war production effort in their own communities in order to find out the type of routine jobs for which short-time training may be provided either as curricular or extracurricular activities in the high school. Furthermore, there is a need to investigate the desirability of designing night courses for adults and part-time training for those already on the job in our defense industries. Then it might be possible, in order that outlays for equipment would not be prohibitive, for various schools to divide among themselves the responsibilities for short-time training for each of the positions for which the demand is most urgent.

A third proposal appears as a possibility also. You are, no doubt, familiar with the many workshops that have been held in connection with university summer schools. In these workshops the participants bring in their own problems with which they are confronted in the actual teaching situation. It may be possible that science teachers have problems related to the central theme of "The Science Teacher's Place in the All-out Effort of the War Offensive," which would be appropriately subject to attack in a workshop procedure. I feel sure that I am able to speak for the Iowa State College when I say that the staff and facilities of this college are available for any help that we may give

IN my opinion, it would be a mistake in thinking through the problems of redesigning science courses to think in terms of the high school boys only. In spite of the short duration of World War I, it was becoming necessary by the time of the signing of the Armistice to utilize many young women in routine jobs. Even the most optimistic one of us would not predict such a short duration for the present war.

BOOK SHELF

Tours Through the World of Science. William T. Skilling, State Teachers College, San Diego, California. McGraw-Hill Book Company, New York, 1941. 815 pages. 371 illustrations. $1.70, list price.

TOURS through the World of Science, in this revised edition, not only retains its former good features but shows marked improvement, especially in adjusting the material to a more functional presentation and the introduction of other material that brings it up to date in terms of modern science as well as educational thought. The chapter on "Communiations by Wire and Radio," "How Plants Live and How We Should Treat Them," and "What the World is Learning About Food" are particularly to be commended.

The author has the knack of putting ideas, ordinarily difficult to understand, into easily understood form. Also he shows that he knows the language of the group for which he has written.

The home projects given at the end of each unit are well suited to capture the interest of the general science age group.

The book is well illustrated and the print is exceptionally easy to read.

The Earth and Its Resources. Vernon C. Finch, University of Wisconsin; Glenn T. Trewartha, University of Wisconsin; and M. H. Shearer, Westport High School, Kansas City, Missouri. McGraw-Hill Book Company, New York, 1941. 634 pages. $2.40, list price.

The Earth and Its Resources supplies a definite need for a text in earth science in the high school. As such it fits well into the natural science and social science program of the school. Earth science, which it presents, is fundamental in other sciences to an understanding of many basic features, such as conservaion in biology, and the enriching of soils in chemistry. For the social sciences it lays the groundwork for understanding the environment, which profoundly affects the natural adjustments of man in economic as well as social ways.

The essental features of the environment are presented under the main headings "(1) the atmosphere: weather and climate; (2) landforms: plains, plateaus, hill country and mountains; (3) the oceans and their shores; (4) earth resources: waters, vegetation, soils and minerals." This treatment is applied to the various types of regions, such as climactic and landforms, and in various combinations to make clear how the physical features affect the environment.

The material has been written in language easily understood by the high school student and is clear in presentation of facts and reasoning. There is a wealth of illustrative material.

Ultra-High Frequency Techniques, Brainerd, Koehler, Reich and Woodruff. D. Van Nostrand. $4.50 list.

An excellent source book of information for the trained electrical engineer or physicist. Students with adequate preparation in mathematics and physics or engineering will find this invaluable not only because it introduces the subject of ultra-high frequency techniques in an understandable way, but also because it offers a fine review of fundamental electrical and radio theory. One of its great values as a teaching device lies in the fact that conclusions arrived at by mathematical derivation are interpreted physically. The authors are probably excellent teachers. The only drawback to this volume is the type of reproduction, made from typewritten copy, which, as the authors explain, was due to the extreme urgency in which there is great need for people trained in this field for service in the armed forces.

Nat Levy
Instructor, Hunter College, N. Y.
Evening Session

Radio Troubleshooter's Handbook; 700 pages, 1941. *Modern Radio Servicing;* 1300 pages; 1935. *Radio Physics Course;* 1933; 970 pages. Alfred A. Ghirardi. Each $5.00 list.

These form an interesting and valuable trio for the student of radio, or for the science teacher who has determined to extend his knowledge into this important field of modern technology. It is of particular interest to the teacher that about one third of the Servicing book is devoted to a description of measuring and testing instruments with detailed suggestions for constructiing homemade kits around a suitable meter. Both this and the Physics Course are written in such detail as to make them valuable for "self learning."

The Handbook, containing an extensive compilation of data, information and "case histories," may be considered as an optional addition to the prospective serviceman's library. Radio transmission is almost ignored in the Physics book. The oscilloscope and the vacuum tube voltmenter are briefly treated in the Servicing book.—J. S.

Outlines of Economic Zoology, 4th Edition, Albert M. Reese. 359 pages. 1942. The Blackiston Co., Philadelphia, Pa. $3.25 list.

This text presents an interestingly organized, well illustrated survey of practical materal of interest to the student of economic zoology, and provides worthwhile supplementary reading for the students of general biology as well. The important problems of conservation are stressed. Beneficial and harmful roles of the various groups of animals are well exemplified.—J. S.

Man and His Physical World, Dwight E. Gray. 660 pages. 1942. D. Van Nostrand, N. Y. C. $3.75 list.

Written in fascinating style, fairly well illustrated, each chapter is followed by discussion questions and test exercises enhancing its usefulness as a science survey text in the physical science fields. The teacher of general science, too, will find in it inspirational and stimulating reading. Subjects are brought up to date, with discussion of artificial rubber and other synthetics as well as latest developments in illumination, to mention two examples. In his discussion of the scientific method, Gray seems, here and there, to approach some of the vital forces which have interacted with the development of scientific thought, mentioning, for example, the impact of theological dogma.

Some Useful Materials

Available Free

The following materials may be secured free from the spencer Lens Company, Buffalo, New York. The materials are desidned especially for the use of science teachers and are quite desirable both from the standpoint of information and instruction.

Effective Use and Proper Care of the Microscope.— A u0 page booklet giving much information that is useful for the beginner in the use of the microscope as well as the advanced student. Illustrated. Along with this may be secured two large sheets, one of which pictures the microscope and gives its mechanical and optical features. The other serves as a good test of student knowledge of the microscope.

Opaque Projection.— A 32 page booklet showing the possibilities of improving teaching through the use of opaque projection. Illustrated. It covers both grades and high school.

Spencer Spectrometer.— A 38 page booklet giving a precise explanation of the use of the spectroscope. It discusses the refraction of light through prisms, how to use the spectrometer, refractive index measurements, spectrum photography, and diffraction grating measurement.

The Use of the Spencer Polarimeter.— A 32 page booklet presenting the theory and use of the polarimeter. Some experiments and applications are given. Well illustrated.

I Saw Them Making Microscopes.—A 19 page booklet describing the making of the microscope in an interesting way. Suitable for high school biology classes. Illustrated.

The Evolution of the Microscope.— A 23 page booklet giving the history of the microscope. Illustrated.